

Concrete

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No. 1



THIS IS DOROTHY LOUISE ROBERTS, HARLAN, KENTUCKY.

She is a 17-year old high school girl, and the fourth winner of the H. S. Firestone Four Year University Scholarship. Her essay, "The Influence of Highway Transport Upon the Religious Life of My Community," entered in a national contest conducted by the Highway Education Board, was chosen as the best of 150,000 submitted. National judges were: The Secretary of War, John W. Weeks; Bishop William F. Anderson, Methodist Episcopal Church, Cincinnati, Ohio, and Dr. Albert Shaw, Editor of *The American Review of Reviews*, New York City. The scholarship pays all college expenses for four years, and is valued at \$1,000 annually.

The Influence of Highway Transport Upon the Religious Life of My Community

BY DOROTHY LOUISE ROBERTS
HARLAN, KY.

The Appian Way, most famous of Roman highways, was called by Horace Bushnell "the Queen of Roads." In establishing Christianity, Paul and other early Christians made great use of the twenty-nine famous military roads radiating from Rome. "And so we came to Rome. And . . . the brethren . . .

came to meet us as far as The Market of Appius." And it came to pass that Rome, having the greatest road, built later the greatest church, St. Peter's. The greatest church of Christianity built at the end of the greatest highway. Strange coincidence! Here is food for thought. From the very first, the mightiest of all religions went forward upon the great highways of travel.

The present writer lives in the mountains of South-eastern Kentucky, where the religious life is backward, and the roads almost impassable. The purpose of this paper is to show how these two facts affect each other. One dislikes to write anything uncomplimentary of one's own community, but one should study conditions before suggesting remedies.

A survey of Harlan County shows forty-seven churches, with thirty-six ordained and licensed preachers. Excepting four churches in the county seat, these are weak, struggling organizations, located principally in mining camps, served by untrained preachers. These men, most of whom could with difficulty pass the entrance examinations of a first-class high school, work at the mines or elsewhere throughout the week, having little leisure for study or preparation. Such leadership develops only religion of the emotional, irresponsible type.

Statistics from our criminal courts indicate that these outlying churches fail to meet the situation. Recently within four days in this locality twelve persons met violent deaths.

General lawlessness is not in reality the cause of crime. It is only the outward symptom. It suggests ignorance; the people do not know. With sapped vitality and weak morals go sluggish minds. Large families live in poor, small houses; the death rate is high. In one school a hook-worm clinic showed ninety-nine per cent of the pupils were afflicted. Religion should not be blind to physical facts. Effective churches would make such unwholesome facts impossible. Disease, crime, irreligion, these exist where people do not know what is good in character or right in conduct.

If it be true that ignorance explains the backwardness of this territory, then both the church and school are needed to counteract it. Religious and educational effort here rise and fall together. Good churches foster good schools. Vigorous churches and centralized schools are impossible in rural sections without good roads. Our isolation is the cause of our ignorance. We would have somewhere to go and something to get, if we had some way of going. Three dollars to ride five miles in a Harlan jitney! The average car is a hopeless wreck after one year of steady bumping over ridges and washouts. *My kingdom for a highway!*

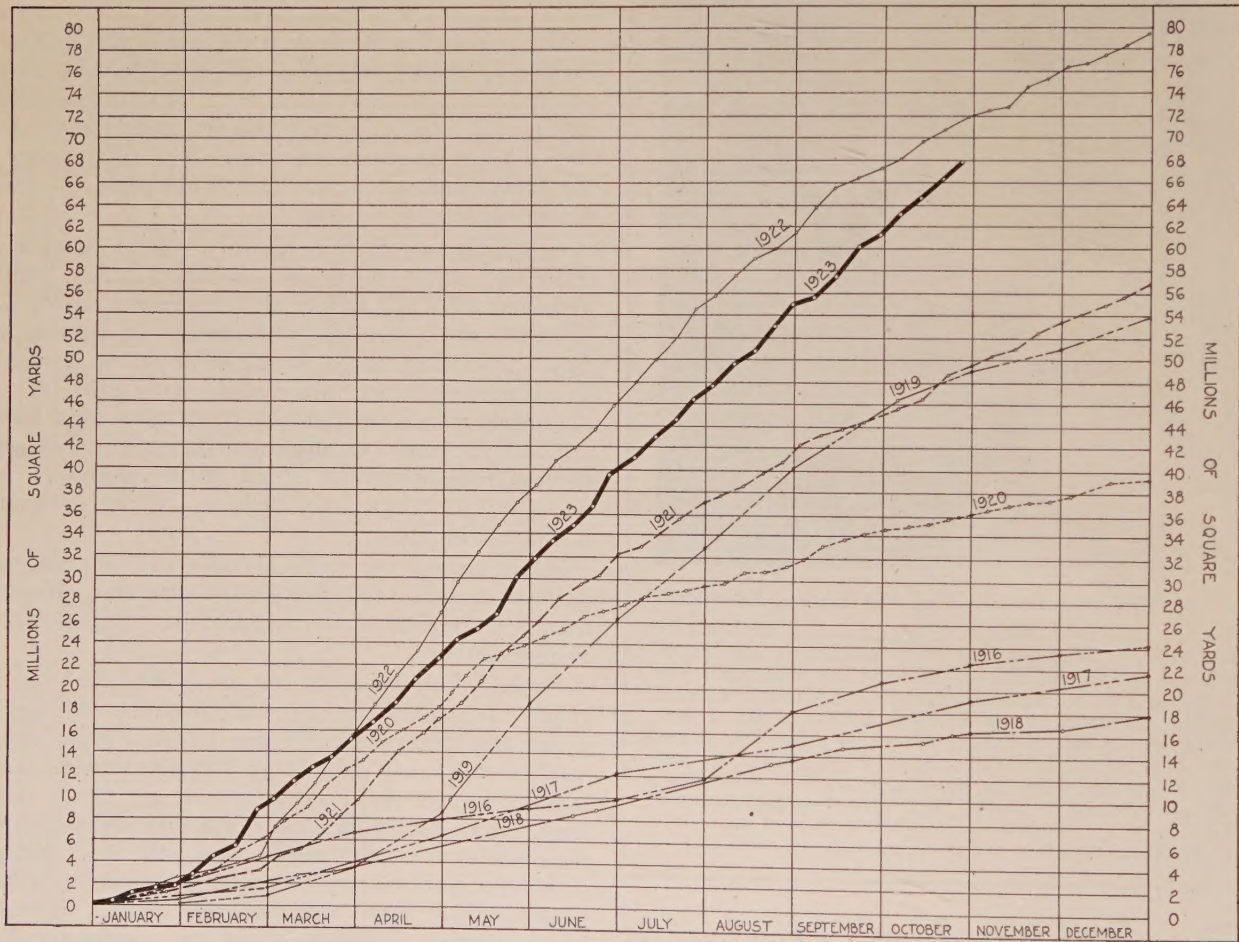
Among our agricultural folk old farming methods

prevail. The mountaineer wrests a few hundred dollars where he should get a thousand. The jitney, auto truck and family car will be chariots from heaven, solving our isolation. Good roads will encourage the auto truck, diversity of crops, improved farming methods, cooperative selling, contentment, and an increase of the economic surplus. This surplus we will invest in churches and schools. Good roads will mean fewer churches, but better, larger ones; fewer ministers, but better trained, educated community

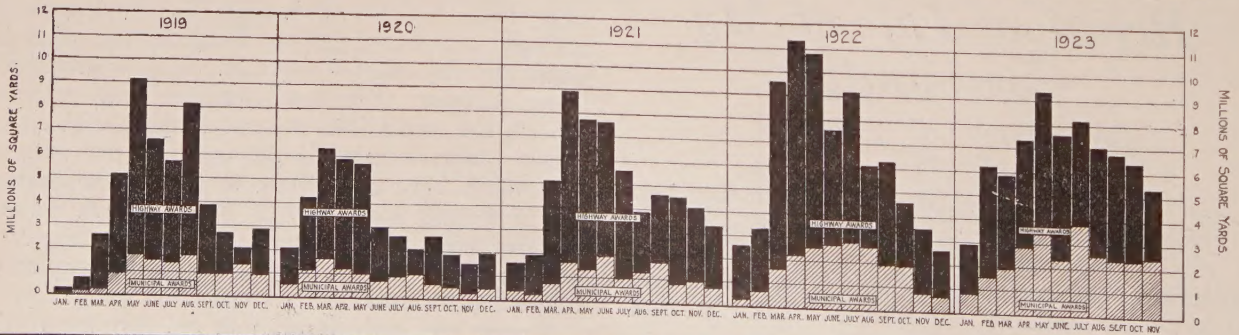
leaders. So Harlan County must build her Appian Ways, that modern apostles may have highways for the new program of evangelism and education. "And a highway shall be there, and a way, and it shall be called the way of holiness; . . . it shall be for the redeemed." Out of such material things as stone and cement must we build through our mountains the highways leading to the goal of our spiritual desires—religious education for all.

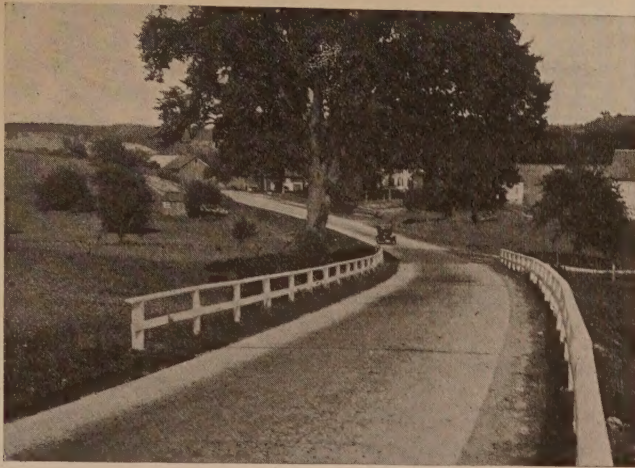
Millions of Square Yards of Concrete, 1918 to 1923

(SEE MR. EGE'S DISCUSSION ON OPPOSITE PAGE)



Monthly Awards for Five Years Show Better Distribution in 1923





ON THE OXFORD GREENE ROAD, CHENANGO COUNTY, N. Y.



CONCRETE ROAD IN DEVIL'S LAKE STATE PARK, WISCONSIN

Progress in Concrete Road Construction and Design in 1923

Review of Year

BY C. R. EGE

MANAGER HIGHWAYS BUREAU PORTLAND CEMENT ASSOCIATION
CHICAGO

Details of design of concrete roads have been modified in 1923, by certain important lessons gained from the tests made at Pittsburg, Calif., and, later, at Springfield, Ill. The Pittsburg studies proved the serviceability of the thickened edge section. This was first adopted, on an extensive scale, for the concrete road system of Maricopa County, Arizona; although the principle had been recognized some years previously in Wayne County, Mich., in Cuyahoga County, Ohio, and by the California State Highway Department. It remained for the research project known as the Bates Experimental Road, carried out under Clifford Older, Chief Highway Engineer of Illinois, to show just how important it is to strengthen the edges and corners of pavement slabs. The scope of the Bates Road project attracted the attention of engineers in all parts of the world. The cordial welcome extended by Mr. Older, and the fine courtesy of his assistants, to all visitors, encouraged wide appreciation of the facts that were being uncovered and proved.

As one result of this research project, the standard Illinois cross-section was changed from a uniform thickness of 7 in. to 9 in. at the outer edges, reducing to 6 or 7 ins. in 2 ft., the balance of the section being uniformly 6 or 7 ins. thick, depending upon local conditions. About 1,000 miles of road have been built in Illinois, during 1923, of this cross-section. It has been adopted, substantially or with various modifications, in other states as follows:

Discussions by: C. R. Ege, A. T. Goldbeck, B. H. Piepmeier, R. M. Morton, H. M. Loy, H. J. Kuelling, C. D. Buck, B. S. Pease, G. C. Dillman, Winston E. Wheat, H. F. Clemmer, R. W. Crum, R. H. Baker, Clifford Older and Utah State Road Commission.

Delaware
District of Columbia
Louisiana (Caddo Parish)
Montana
New York
Ohio
Pennsylvania
South Dakota
Texas
Utah
Virginia
Washington

It is probable this list will be increased as new plans for 1924 are formulated. There are also a number of states which continue to use a uniform thickness, but provide for special reinforcement along the edges.

Specifications for concrete pavement aggregates show important general improvement, and increased attention has been given to testing and field inspection. This is especially true in regard to quality of sand. The mortar test for tensile strength continues to be a feature of most specifications, in spite of the fact that it gives no reliable information as to the concrete making property of sand, and may be especially misleading as a criterion for concrete pavement material.

An accompanying chart shows the monthly awards of concrete pavement contracts for five years past. The outline for 1923 shows clearly the tendency to make offerings throughout the year, instead of bunching them into the early months. Coupled with this practice is that of enabling contractors to accept material deliveries for storage, by allowing cash payments for acceptable material and suitable storage. This insures the contractor against delays due to shortage of rail facilities, spreads out the peak of car movement, and increases the amount of pavement actually completed during the working season.

Up to November 1, over 74,000,000 sq. yds. of concrete, including streets and alleys, were placed

during 1923. This is an increase of more than 18% over the amount actually laid in 1922.

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SQUARE YARDS CONCRETE PAVEMENT AWARDED AND CONSTRUCTED IN THE UNITED STATES

	Awarded During Year	Completed During Year	Carried to Next Year
1919	52,900,000	25,900,000	27,000,000
1920	39,000,000	35,800,000	30,200,000
1921	56,200,000	63,600,000	22,800,000
1922	79,200,000	65,300,000	36,700,000
1923 (11 months only)	73,000,000	74,000,000	35,700,000

TABLE OF EQUIVALENT CONCRETE HIGHWAY MILEAGE
ALL WIDTHS OF PAVEMENT REDUCED TO EQUIVALENT MILEAGE OF 18-FOOT WIDTH

State	Concrete Highway Mileage Built During 1923—To November 1	Total Concrete Highway Mileage Built Since 1909 To November 1, 1923
Alabama.....	5	40
Arizona.....	49	413
Arkansas.....	23	149
California.....	157	3,281
Colorado.....	28	137
Connecticut.....	39	246
Delaware.....	76	289
District of Columbia.....	39	8
Florida.....	50	97
Georgia.....	971 1/8	36
Idaho.....	265	2,920
Illinois.....	88	1,151
Indiana.....	93	431
Iowa.....	23	407
Kansas.....	4	103
Kentucky.....	10	11
Louisiana.....	116	64
Maine.....	26	850
Maryland.....	301	186
Massachusetts.....	84	1,448
Michigan.....	28	453
Minnesota.....	121	154
Mississippi.....	19	309
Missouri.....	2	27
Montana.....	3	55
Nebraska.....	124	29
Nevada.....	7	8
New Hampshire.....	382	537
New Jersey.....	298	59
New Mexico.....		2,228
New York.....		557
North Carolina.....		

North Dakota.....	1 1/2	4
Ohio.....	223	1,381
Oklahoma.....	42	238
Oregon.....	32	196
Pennsylvania.....	353	2,071
Rhode Island.....	6	32
South Carolina.....	20	140
South Dakota.....	1	1
Tennessee.....	11	52
Texas.....	46	357
Utah.....	10	217
Vermont.....		8
Virginia.....	104	487
Washington.....	92	980
West Virginia.....	99	518
Wisconsin.....	426	1,546
Wyoming.....	..	13
Total for U. S.....	4,897	25,230
British Columbia.....	10	31
Total 1923 to November 1.....	4,907	
Grand Total.....		25,261

December 4, 1923.

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Outstanding Developments of the
Past Year

By A. T. GOLDBECK
CHIEF, DIVISION OF TESTS, U. S. BUREAU OF PUBLIC ROADS

More rapid progress is being made in the development of a rational basis for concrete road design than now seems apparent. The major researches in road design all point to the efficiency of thickened edge construction, and tentative rules at least are now available for the proportioning of concrete slabs which will safely carry given wheel loads. It is evident that highway engineers are beginning to make use of research information for scientifically designing their pavements. Concrete road design is rapidly becoming a science. Future research should extend to the sub-grade and to the more scientific design and placement of reinforcing steel. Methods of field control are being



ON THE PACIFIC HIGHWAY, SKAGIT COUNTY, WASHINGTON.
BUILT IN 1921



BINGHAMTON, CHENANGO FORKS ROAD, BROOME COUNTY,
N. Y., BUILT IN 1920

CONCRETE

developed which will make for uniformity of concrete road construction so much to be desired. Immediate effort should be directed toward hastening the perfection of construction methods which will make for uniformity of proportioning, mixing, placing, finishing and curing.

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Missouri's Design Changes

By B. H. PIEPMEIER

CHIEF ENGINEER, MISSOURI STATE HIGHWAY COMMISSION
JEFFERSON CITY

The outstanding developments in the designing of concrete pavements are the thickening and reinforcing of the edges of the pavement and possibly the thinning down of the center of the pavement, thereby making a more balanced design to meet the traffic requirements.

The longitudinal central joint edged on the surface of the pavement is being used in concrete road construction in Missouri.

The predominating points in concrete road construction in Missouri are the securing of a uniform subgrade full thickness of pavement as specified, careful gradation and selection of aggregates to insure maximum strength, full one minute mix, a uniformly stiff mix of concrete, more attention in acquiring a perfectly smooth pavement and a uniform and thorough curing of the concrete. These outstanding features are insuring for us a much better pavement than has ever been built in the past.

In Missouri we have built several sections of pavement with a nine-inch edge and a five-inch center thickness as a concrete foundation, the idea being that such a section of road can be used for a number of years as a finished pavement, after which a wearing surface can be constructed, when traffic demands it. When high grade aggregates are available the concrete mix has been varied from 1:2:3½, which is the State's standard mix for concrete pavements, to 1:3:5. The leaner mix being used only where aggregates insure high strength and where traffic is comparatively light.

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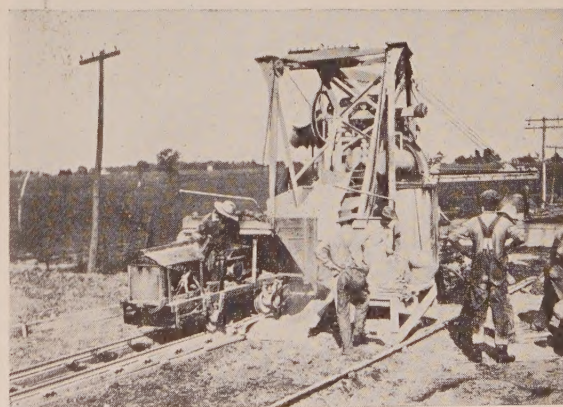
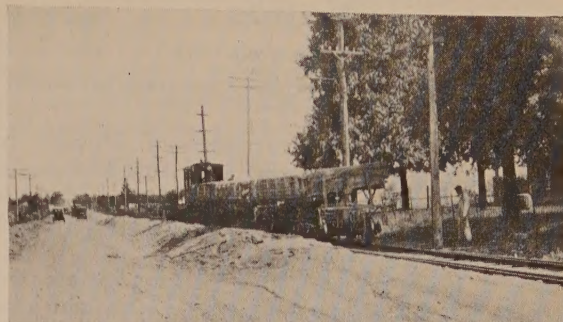
New Specifications in California

By R. M. MORTON

STATE HIGHWAY ENGINEER
SACRAMENTO, CAL.

California has constructed very little concrete pavement during the past year, practically all of the work done has been under contracts awarded in 1922; on some of these contracts specifications have been modified so as to increase the thickness of the pavement. New specifications under which we expect to advertise several sections of highway shortly will provide for a minimum thickness of 6 in. with edges increased to 9 in. in 3 ft. Only in exceptional cases will reinforcement be used. The minimum width will be 20 ft.; center paper joints will be provided and we are considering expansion joints 1½ in. in width, spaced 100 ft. apart, filled with a mixture of asphalt and sawdust.

Most of our pavement work during the next few years will be reconstruction work, the cost of which will be defrayed from gasoline tax revenues, and each job will constitute a separate study as to the width and type of resurfacing. The minimum width will be 20 ft. and we shall build up to 40 ft. on highways carrying 5000 vehicles a day.



NATIONAL ROAD, HANCOCK, INDIANA, C. M. KIRKPATRICK, CONTRACTOR

TOP TO BOTTOM—AGGREGATES DELIVERED ON SUBGRADE BY INTERURBAN RY. 2ND—WINCH FOR DRAGGING ENTIRE TRACK AND SWITCHES AHEAD AS MIXER PROGRESSES. 3RD—BARBER-GREENE LOADER FOR TAKING AGGREGATES FROM SUBGRADE AND STORAGE PILES AND LOADING INTO TRUCKS. 4TH—SMALL TRUCK ON RAILS DUMPING INTO MIXER SKIP

Expansion Joint Changes in Nevada

H. M. Loy

ASSISTANT STATE HIGHWAY ENGINEER, NEVADA, DEPARTMENT OF HIGHWAYS
CARSON CITY

The State Highway Department of Nevada has made only a few minor changes in the specifications for concrete pavements in the last two years. The most important of these changes is the one referring to transverse expansion joints.

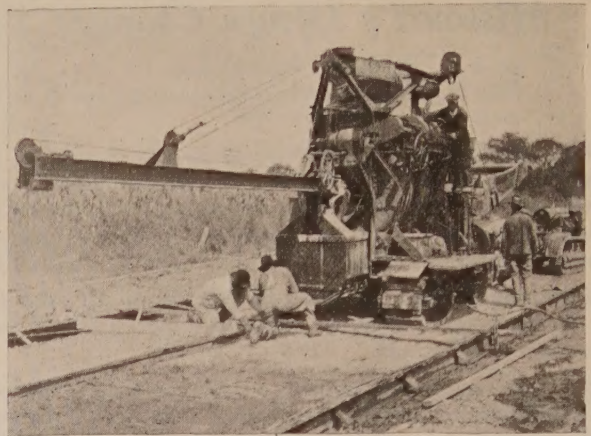
Prior to 1922, pre-molded expansion joints were placed at intervals of approximately 33 ft., and joints one-half inch in thickness were used. We found that, in the early spring, excessive expansion of the pavement occurred and that the thickness of these joints was not sufficient to provide for this expansion. We also found that about one joint out of four was active, and that at the other joints there was no apparent compression of the joint material. At the active joints, either one or both of the concrete slabs would become displaced.

In 1922, we changed our joint specifications so that pre-moulded asphalt joints one-half inch in thickness were placed at 100 ft. intervals. Considerable concrete pavement has since been laid with transverse joints placed in this manner, and we have not experienced the difficulty from excessive expansion. We find that transverse cracks appear in the pavement at 25 to 30 ft. intervals between joints. As soon as these appear they are filled with a heavy asphalt, which is heated to a liquid.

In the construction of the expansion joints, 7-inch joint material is used for a 6-inch pavement. The concrete on each side of the joint is finished with a split float and is edged along the joint with a side-walk edging tool one-half inch in radius. After the concrete is completely set, and prior to opening the

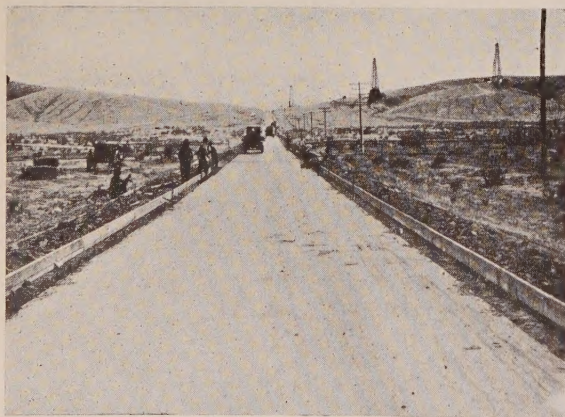
pavement to traffic, the joint is trimmed to one-half inch above the concrete surface, and the excess material ironed down with hot irons until flush with the pavement. This provides a reservoir of material to take care of the initial expansion.

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SETTING STEEL FOR LONGITUDINAL JOINT ON DIXIE HIGHWAY, KENTON COUNTY, KENTUCKY. JOHN WROE, CONTRACTOR

VERHEY CONSTRUCTION CO. PLANT—STORAGE OF AGGREGATES FOR CHAMPAIGN COUNTY, ILLINOIS CONTRACT



RESURFACING AND WIDENING TAFT-BAKERSFIELD ROAD, KERN COUNTY, CALIF.

Road Design a Matter of Locality

By H. J. KUELLING

CONSTRUCTION ENGINEER, WISCONSIN HIGHWAY COMMISSION
MADISON

DESIGN

Engineers are coming more and more to realize that it is a matter of locality—that is, a design for one part of the United States does not necessarily fit another section. A few points, however, I believe are becoming well standardized.

First of all, the convention at New Orleans seemed to bring out the fact that a stronger edge is to be desired; that is, stronger than was the custom for the past several years. This strengthening can be brought about either by a reinforcing or by thickening the edge, or by both.

Another feature of design that seems to be fairly well established in certain sections is the matter of splitting the pavement down the middle. This is especially true in areas where frosts exist to a considerable degree and in those areas especially where clay soils exist. The writer believes that center dividing plates should be of a light steel, probably 18-gauge, and that they should have some mechanical installation bar to hold them in line while being placed.

In designing pavements to determine thicknesses, widths, etc., it should not be overlooked that the design should also cover the question of quality of materials. The writer believes that the biggest saving

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in strength and costs along this line can be accomplished by improving the quality of sand specifications in a large number of states. For instance, a practically unanimous specification is that sand, when mixed with cement in a 1:3 mixture, shall be the equal of a similar mixture with Ottawa sand.

In some states, including Wisconsin, our sand tests run as high as 18% of standard Ottawa. The writer sees no reason why the specifications should not demand more than 100% of standard Ottawa.

PRACTICE

In spite of all that has been written on the subject, the writer believes that the matter of inspection is still one of the weak things in concrete road construction. There are so many things that can happen which cannot be corrected after 24 hours, that too much attention cannot be given to inspection.

One of the greatest dangers confronting the proper construction and which might easily counteract the very best design, is the matter of stock piling of aggregates. Time after time the writer has observed stock piles of coarse aggregate in more or less conical shape, where the center core had almost enough or even enough fine aggregate to make good concrete without the addition of any sand. Stock piling should be given the most careful attention by the inspection department to see that it is piled in layers and not allowed to separate.

Better measurement of materials to get a uniform batch is desirable in many places. Measuring devices should be of such a nature that when full they contain the maximum amount per batch. Then, if any error occurs, it will be on the side of safety. The writer believes that in the future, aggregates will be weighed, this being done now in a number of places, and that where the very best results are desired, the coarse aggregate will be brought to the job in two or more sizes, thus preventing segregation and guaranteeing a more uniform mix of materials.

In the matter of finishing machines, it is still the writer's belief that they are misnamed when called

finishing machines, as they are more properly striking off and tamping machines. The writer believes that any great agitation of the mixed concrete brings all the undesirable materials to the surface and, unless these are rolled or struck off from the surface, there is considerable danger of scaling. I believe this is especially true where too much tamping takes place.

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Design and Construction Practice in Delaware

By C. D. BUCK

CHIEF ENGINEER, STATE HIGHWAY DEPARTMENT
DOVER, DEL.

Because practice has been standardized and universally adopted by the States it is becoming more difficult each year to discuss new ideas that have developed during the year in concrete road construction.

DESIGN

In Delaware we have adopted a modification of the Illinois section; the cross section being two arcs of a circle, the center depth 6 in., the edge 7 and 8 in. A center longitudinal joint is used in pavements 18 ft. or over in width. No reinforcement is used in the slabs. This choice of design we believe is ideally suited to Delaware's climatic and subgrade conditions. There has been no increase in cost of preparing the subgrade either by hand or subgrade machines.

PRACTICE

A noticeable improvement in smoothness of finish has been experienced when the concrete has been screeded twice with a heavy screed, the use of a roller and bow belt omitted; and the excess water removed and pavement finished by means of a muslin or burlap rag.

Due to a war-time measure coarse aggregate has included 20% ballast. This ballast coupled with the removal of intermediate sizes, a practice more or less common with the quarries, has had an injurious effect in securing a smooth finish, especially when finished by hand. We intend to remedy the condition by changing the specifications so the maximum size of coarse aggregate shall not be over $2\frac{1}{4}$ in.

The practice of bolting 2 x 4 pieces to the bottom edge of forms in order to make up the necessary side depth should not be permitted. No forms but the depth called for should be used.

As a safety measure the marking of the center line of concrete pavements has been carried on extensively this year. A truck holding 400 gallons of asphalt feeds automatically into a small machine which places the hot asphalt directly on the concrete in a mark 3 in. wide. This machine marks approximately 15 miles of road a day. The use of asphalt has been found cheaper and more satisfactory than any of the commercial paints for this purpose.

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Road Reinforcing

By B. S. PEASE

AMERICAN STEEL & WIRE CO.
CHICAGO, ILL.

The present style in concrete highway slabs in a number of states calls for thickened edges reinforced with a $\frac{3}{4}$ -in. bar, thinner centers and center joints. Such a section has a number of theoretical advantages, but there are certain inherent weaknesses that have not



OGEECHEE CONCRETE ROAD NEAR SAVANNAH, GA.

as yet been overcome. The irregular section requires additional labor for fine grading. Although the $\frac{3}{4}$ -in. edge bar undoubtedly strengthens the outside corners, it is painted and therefore cannot act as a true reinforcing bar. Experience shows that this bar wears slots in the slab adjacent to transverse joints or cracks. In general no adequate means have been employed to strengthen inside corners at the junction of the center joint with transverse cracks and joints. The logical method of overcoming the more important disadvantages of this section is to adequately reinforce it with a wire fabric reinforcement, which experience shows will tie the slab together and bind any transverse or other cracks that may form so that they will not open up. The sections in the Bates Road test slab of the Illinois Highway Department that were reinforced with a wire fabric weighing 45 pounds per 100 sq. ft. showed conclusively that cracks in concrete pavements can be so bound as to prevent progressive failures.

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Michigan Design and Construction Practice

By G. C. DILLMAN

DEPUTY COMMISSIONER, STATE HIGHWAY DEPARTMENT
LANSING, MICH.

In the season of 1923 we completed in the neighborhood of 225 miles of concrete pavement and we believe the general workmanship, especially finish, is much better than what we accomplished in previous years. Much closer supervision was had over the work, and largely through the straight-edging of all this type of pavement, the finish has been much better which results in excellent riding qualities.

We are specifying the marginal bar for the concrete slab in most cases and our design calls for an 8-inch slab as a rule with the 9-inch slab on especially heavy duty roads. We use the bar mat reinforcement over questionable grades.

Regardless of the fact that many of the states have discontinued the expansion joint construction, we feel that this is quite necessary; during the coming year shall continue the placing of three-quarter-inch expansion joints every 150 to 250 ft.

We are convinced that the matter of sub-grade treatment should be given more attention and heavy clay soils should have either an add-mixture or covering of porous material such as sand, gravel or stone.

Our sub-grade work has improved considerably, inasmuch as more attention is being given this item of work which has resulted in pavements of almost constant depth, being determined by means of taking cores at frequent intervals on most jobs.

On pavements of eighteen feet or more in width, we use the central joint. This, we find, has largely eliminated the undesirable rambling longitudinal cracking that almost invariably happens after the pavement has been down one year or more. It also gives a distinguished traffic line which is of some value.

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3,000-Lb. Concrete Is Required

By WINSTON E. WHEAT

COUNTY ENGINEER, COUNTY OF ESCAMBIA,
PENSACOLA, FLORIDA

To my mind, the outstanding recent development in concrete highway work is the growing use of carefully

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DIXIE HIGHWAY, COOK COUNTY, ILL., SOUTH OF CHICAGO HEIGHTS

Top to Bottom—Condition of Old Asphalt Top before Resurfacing with Concrete. 2nd—Old Top Removed. 3rd—Laying Concrete, Machine Finish. 4th—The New Concrete Surface, April 1923

proportioned mixtures, and water control, based upon the results of investigations such as those conducted by Prof. Duff Abrams of the Lewis Institute. Concrete is on the high road to success in this field if a 3,000-lb. strength mix is consistently used on any one of the slab designs now generally specified.

We have shown our faith by our works in this county. On all of our county concrete roadwork we insist on a 3,000-lb. concrete.

Subgrade Support a Factor in Pavement Design

By H. F. CLEMMER
ENGINEER OF MATERIALS
ILLINOIS DIVISION OF HIGHWAYS

Highway engineers throughout this country as well as foreign nations are recognizing to a greater degree than ever before the value and need of investigation and research in materials, methods and design employed in the construction of pavements. At the several highway conventions held each year, the programs reflect the importance assigned to these research problems by leading road builders of the country. So great has been this need for further and definite information on the theoretical side of road building that not only the U. S. Bureau of Public Roads but the various bureaus of the state highway departments have taken up the investigation of the problems with which they are most concerned.

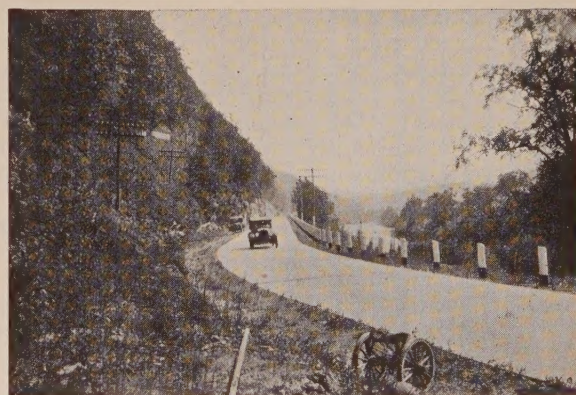
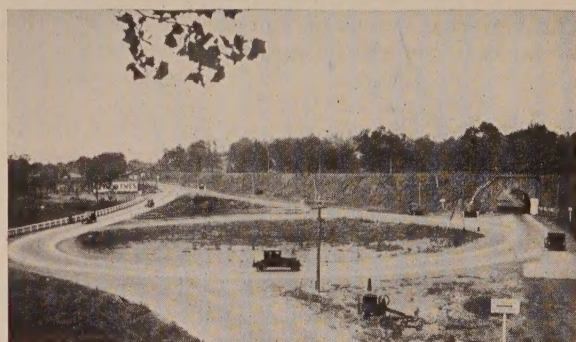
The Illinois Bureau of Materials has for the past few years been engaged in a research program of considerable scope which may be roughly classified into the investigation of concrete pavements slabs stresses and movements under varied conditions of temperature, moisture and load; subgrade soil analysis, bearing power, moisture and movement under the same varied conditions; curing and accelerating materials for concrete; gradation, wear, porosity, strength and other characteristics of aggregates and their effect on quality of concrete; and in addition the many tests incident to the traffic runs on the Bates Experimental Road.

In the design of pavements there enter in several variable factors of which one of the most important is that of subgrade support or bearing power. During the past few years the work of the Illinois Bureau of Materials on subgrade characteristics has been conducted along several separate lines of investigation. At the time of construction of the Bates Road sections, a series of experiments on the bearing power of the subsoil under these sections was begun. At this time the static and repeated load bearing power determinators were designed and data were obtained by loading, both statically and intermittently, several circular concrete slabs placed in the shoulder at the same level as the pavement slab. Beginning at the same time and continuing until today moisture determinations of subgrades under all conditions, both drained and undrained, have been made at regular weekly intervals. The results which have been obtained have been surprising yet consistent.

Early last year samples of typical Illinois subgrade soils, 13 in number, were transplanted at the Research Laboratory in Springfield and an examination of the properties of these soils begun on a laboratory scale through the use of original methods and specially designed apparatus for the determination of bearing power, porosity, absorption, capillarity and many other characteristics. By means of this work it is hoped to definitely classify Illinois soils into subgrade materials whose action under various conditions of weather and load will be known.

Although the factor of soil support is but one of several entering into pavement slab design; the determination of the amount and nature of this support will be an important step in the development of economic highway design.

Conclusions drawn in the work so far indicate that the supporting strength of a subgrade soil varies with the moisture content. Laboratory experiments have also shown that the water holding capacity, capillarity and other moisture characteristics of any soil vary with its physical constitution. It therefore naturally



FOX RIVER TRAIL, KANE COUNTY, ILLINOIS
YALESVILLE UNDERPASS IMPROVEMENT, NEW HAVEN-HARTFORD ROAD, NEW HAVEN COUNTY, CONNECTICUT
SUSQUEHANNA TRAIL, LYCOMING COUNTY, PENNSYLVANIA

follows that the aim of the Illinois Bureau of Materials in the experiments now under way is to discover some method of varying the physical condition of a soil to control the moisture content and in this way secure the maximum supporting strength. The bearing power of the subgrade of a rigid type pavement is an important factor in the strength of the pavement slab and the work being done on subgrade materials will become of value if it can no more than assign a definite value to the supporting strength of the materials on which roads are being built.

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Iowa Weighs All Aggregates

By R. W. CRUM
ENGINEER MATERIALS AND TESTS, IOWA STATE HIGHWAY COMMISSION,
AMES

The Iowa Highway Commission has recently adopted the practice of actually weighing the aggregates used in pavement construction. It has been

found that materials can be accurately weighed at practically no increase in cost over the volumetric methods formerly used, that considerable improvement in the uniformity of the concrete is secured, that an exact record of all the materials used on a job is kept, and that more accurate estimates of amounts of materials required can be made. Observation of three factors contributed primarily to the decision of the Iowa authorities. Daily tests of strength and composition during 3 years construction called attention most forcibly to the variation in quality of concrete made from day to day. Various controversies concerning the amounts of materials actually used called attention to the need of some more accurate record of qualities used than was afforded by the railroad weights of materials shipped, and variations from estimated quantities also showed the need of more accurate measurements. By stating the proportions of materials by dry weight, and then making correction for moisture content in weighing the aggregates, it is possible to make a very great improvement in all three items.

During 1923, the aggregates were weighed upon two concrete paving contracts, with satisfactory results to both the Highway Commission and the contractors.

On one of these contracts, 26 miles of concrete pavement, 18 ft. wide and 8 in. thick was laid. A central mixing plant having a 2-cu. yd. capacity was used. A single weighing hopper with dial for reading the weight was furnished by the Toledo Scale Company. The weight of the individual charges of sand and gravel was approximately 3,000 lbs.

The other contract was $1\frac{1}{2}$ miles long, and was handled with an industrial railway outfit. Eight weighing hoppers resting upon Fairbanks platform scales were used to load the train of batch boxes. The capacity of the individual scales was 8000 lbs., and the batches were approximately sand 1600 lbs., gravel 3265 lbs.

No delays were experienced on either job, due to the weight method of measuring.

As the result of this experience aggregates used in pavement construction under the jurisdiction of the Iowa Highway Commission will be weighed henceforth.

* * *

Utah Design and Construction

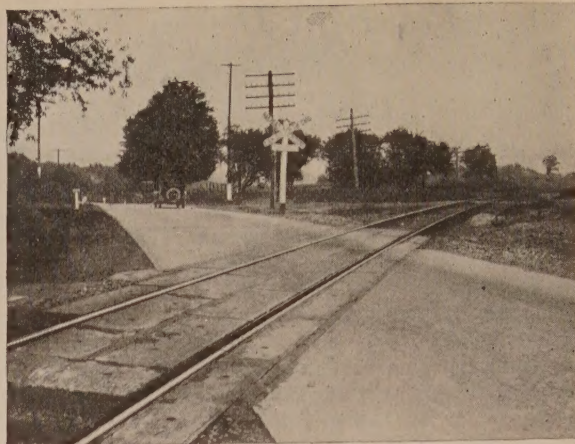
UTAH STATE ROAD COMMISSION

The past year has been noteworthy for the improvement in design of both concrete and gravel roads. The increase in traffic both in weight and in volume and the large sums that have been and which are yet, to be invested in paving and other types of surfacing, have led to a close study in this and other states of the behavior of the types in use and our standard cross sections have been redesigned as a result.

The type of concrete pavement most commonly constructed on our state roads heretofore has been 6- to 8-in. plain concrete, 6 in. thick at the edges and crowned to 8 in. at the center over a flat subgrade. Largely as a result of the above tests this section has been changed to a type similar to that which has been developed in California and Arizona and sometimes called the Maricopa section. In this the thickest concrete instead of being at the center is at the edges which are further strengthened by a $\frac{3}{4}$ -in. steel reinforcing bar running continuously the length of the pavement.

Temperature stresses, it has been ascertained, cause the pavement to warp or "curl", the heat of the sun expanding the upper portion of the pavement during the day and tending to lift the center from the subgrade. The reverse of this at night causes the pave-

[10]



PRECAST RAILWAY CROSSING SLABS, NICKEL PLATE RY., LINCOLN HIGHWAY, PORTER COUNTY, INDIANA

FREEHOLD-MARLBORO ROAD, MONMOUTH COUNTY, NEW JERSEY

ment to lift at the edges, the surface of the pavement being colder and contracting more than the lower part. Experiments have shown that the breaking or cracking of the pavement near the edges and particularly near the transverse expansion joints occurs most frequently at night. To reduce the effect of temperature changes as much as possible a continuous longitudinal joint is placed along the center line of the pavement completely dividing it into two 9-ft. strips.

The form of the joint, which is of steel, is such that the paved strips are notched together to prevent vertical displacement and to further strengthen the joint; transverse reinforcing bars four feet long connect the strips every 5 feet. Transverse joints are placed at approximately 200-ft. intervals or at the completion of each half day's work of placing concrete.

All of the paving contracts let this year have been on this type and consist of 6-in. slab thickened to 8 in. on the edges. Most of the paving carried over from last year was on a heavier section, a 7-in. slab on the Magna-Tooele pavement and $7\frac{1}{2}$ -in. Brigham to Corinne, and on the latter a longitudinal center joint was placed for the last 4000 ft.

* * *

Building Foundations for Future Roads

BY R. H. BAKER

SECOND ASSISTANT, TENNESSEE STATE HIGHWAY ENGINEER, NASHVILLE

The Tennessee Department of Highways and Public Works is launching its construction program for the year 1924 on a larger scale than heretofore by more than one hundred per cent. The funds available, which

January, 1924

are comprised of a balance from the 1923 program, Federal Aid, County contributions, and current revenue, will approximately be \$11,200,000 and construction contracts will be awarded as rapidly as surveys and plans can be finished. In addition to this, there remains approximately \$5,400,000 worth of unfinished work in contracts under construction at the present time, which brings the total value of work to be completed and under construction during the year to approximately \$16,600,000.

In Tennessee, the policy of constructing the grade and drainage structures, and where possible a temporary surfacing of local material, and using the road in that condition until thorough settlement and maturing has been affected, is being followed. The 1924 program is adhering to the policy practically in its entirety in that the majority of the work is for grading and drainage only.

There has been proposed, and the sentiment is supported practically unanimously over the entire State, a bond issue or other revenue raising plan to provide an annual expenditure of State funds of ten million dollars per year, which will insure a program of construction that will permit the completion of the State System of highways in from seven to ten years.

* * *

Longitudinal Joints—Thickened Edges

BY CLIFFORD OLDER

CHIEF HIGHWAY ENGINEER, ILLINOIS DEPARTMENT OF PUBLIC WORKS
AND BUILDINGS, SPRINGFIELD

In considering developments in concrete road design which have crystallized during the past season, two matters seem to be worthy of mention.

First, the use of a longitudinal joint in rural concrete pavements, 16, 18 or 20 ft. wide, seems to be fully justified. Such joints have now been used in service pavements a sufficient length of time to indicate clearly that their use does in fact eliminate longitudinal cracks and by so doing avoids the weak points which otherwise occur where such cracks intersect other cracks or joints at acute angles. Neither in service pavements nor in the Bates test road have weaknesses developed in any way relative to the presence of the joint.

Second, the thickening of the edges of a rural concrete pavement results in a gain in traffic supporting capacity accompanied by a reduction in cost of construction. The operations incident to the shaping of the subgrade in such form as to accommodate the thickened pavement have not proved to be costly or troublesome. Only slight modifications of equipment and routine methods have been necessary.

As to pavement construction, the plant used shows improvement both in the individual units or equipment and in the balanced assemblage of these units in a complete working plant.

The improvement in plant and plant operation has resulted in a greater season's output per outfit than has heretofore been obtained, in spite of the exasperating delays due to unusually frequent rainy days.

Duty-Free to Japan

The Japanese Consulate General has received a cable dispatch from Tokyo transmitting the complete list of foodstuffs, building materials, etc., exempt from import duty under the recent imperial ordinance. Among the articles mentioned are: portland cement, roman cement, puzzolana cement and similar hydraulic cements, bricks, excluding cement bricks and fire bricks.

January, 1924



DUPONT ROAD, SUSSEX COUNTY, DELAWARE—THROUGH ELLENDALE SWAMP

WELSH-NORTH FORK ROAD, MCDOWELL COUNTY, W. VA.—BUILT 1918-1919

Concrete Construction Superintendents will have a special session at the American Concrete Institute Convention in Chicago next month, for the discussion of their own on-the-job problems.

The Invisible Track Highway in Kentucky

By J. T. MADISON

ASSISTANT ENGINEER, COMMONWEALTH OF KENTUCKY
FRANKFORT

While this does not embrace a description of a new use of concrete, it does tell of concrete used in a new design of highway paving and for that reason may be of some interest to the general reader; while to those who are designing and constructing highways it may bring a new suggestion toward the solution of the problem how to secure a good road at less cost than is being paid for present designs.

In the fall months of 1923, the Kentucky Highway Department undertook the construction of about 1600 ft. of Invisible track highway at Pineville, Ky. This was done merely as an experiment to determine how well the design stands up under traffic and what effect the rises between tracks have upon passing vehicles. The main features of the design were looked upon as being correct but there were left some doubts about details of construction and ultimate cost. It was believed that the design was capable of carrying an amount of traffic equal to some other more expensive designs now being built, and that there was a possibility of its decreasing the chance of collisions between moving vehicles that sometimes result when one meets a road hog or a drunken driver. This possible safety provision being due to the ruts or tracks that will serve as guides for each lane of traffic and keep them separated.

BASIS OF DESIGN

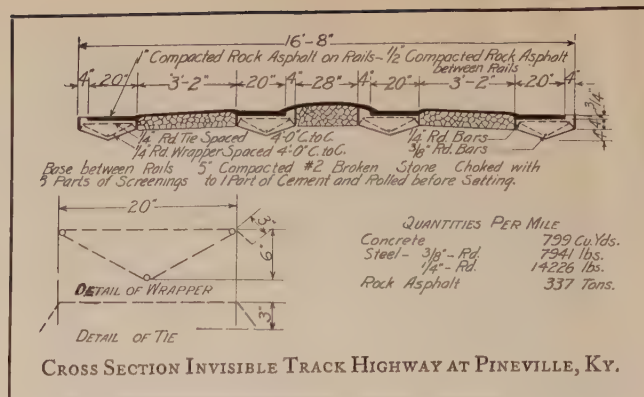
This pavement is designed on the principle that traffic follows a rut or track and that highway officials should furnish a good trackway to start with, designed so that the drivers of motor vehicles will find it easier to follow the tracks than to get out of them.

Under these conditions it follows that the tracks are the parts of the surfacing that must be designed to carry practically all moving loads; so that the area between the tracks need be only sufficiently strong to withstand the passing of fast moving vehicles around a slow moving one.

The concrete girders under the trackways have been designed on the assumption that the sub-grade would offer an effective support for not more than 8 ft. of span, the assumed wheel load being 4000 lbs. The assumption of an 8 ft. clear span was based on experiments made by the Bureau of Public Roads. The bending moment has been calculated on the assumption that the concrete girder acts as a continuous beam. The accompanying cross section of the design illustrates how the road is constructed.

ECONOMIC CONSIDERATIONS

One does not have to be overly well versed in economics to realize that highways costing more per mile than a modern railroad cannot be constructed generally throughout the country, because the tax burden would be not only intolerable, but impossible. If a highway can be designed on plans similar to that of a railroad where the tracks carry all of the load, then it will be possible to use a minimum of materials so placed as to give desired results at a lower cost. This will also bring about the probability of constructing more enduring surfaces on a greater mileage of roads than is possible if present designs are adhered to.



CROSS SECTION INVISIBLE TRACK HIGHWAY AT PINEVILLE, KY.

If the experiment at Pineville gives a favorable result; it is probable that another section will be put down in a different part of the state to demonstrate the adaptability of track road to salvaging old macadam roads where a good base exists but the surface has been badly worn. With specially designed machinery it is thought that costs of construction can be lowered appreciably and the speed of building very much increased over that at Pineville, where hand methods were used almost exclusively.

Difficult Road Job in Kentucky Mountains

By J. M. GARD

PROJECT ENGINEER, KENTUCKY DEPARTMENT OF ROADS AND HIGHWAYS

The contract for 12.5 miles of 15-foot surfacing with widened curves on the Barbourville-Pineville Road in Southeastern Kentucky was awarded to Metzcell, O'Hearn, Vastine and Lewin, contractors, in the late fall of 1922.

The grade and drain work was completed the same year by another contractor. The surfacing consists of a 1:2½:5 concrete base 6 in. thick with a 1½-in. by 6-in. integral curb of a 1:2:3½ mix. The wearing surface consists of a covering of Kentucky Rock Asphalt 1½ in. thick, compacted.

Owing to the bad weather conditions the surfacing was not begun until the spring of 1923. The contractors moved their equipment on to the project about March 1 and erected their cement house, bins and camp buildings. A clam shell mounted on caterpillars was used to unload the sand and coarse aggregate from the cars to the bins or to the storage piles.

When the work of placing the concrete was begun, the materials were transported from the storage bins to the mixer in Ford trucks, equipped with dump bodies. A 1:2½:5 mix was used for the concrete base course. Each truck hauled four sacks of cement, 10 cu. ft. of sand and 20 cu. ft. of coarse aggregate. This weight taxed the trucks rather heavily, especially over a clay and sandy loam sub-base. Oversize pneumatic tires on the rear wheels proved to be the most satisfactory. Sand and the coarse aggregate were dumped into the trucks from automatic batch boxes suspended from the bins. The four sacks of cement were dumped on the trucks after they had received their aggregates. The trucks were turned on a turn table which was kept about 200 feet ahead of the mixer. An average of 18 trucks were used on the concrete haul. The average



FIG. 1—FORD TRUCK WITH DUMP BODY USED TO HAUL MATERIALS—BARBOURVILLE-PINEVILLE ROAD, KENTUCKY

FIG. 2—FINISHING CONCRETE AND PLACING CURB

haul was 2.2 miles. All of the materials were hauled from two set-ups.

The road is located in the mountainous section of the state and about forty percent of its entire length consists of curves that are widened and elevated in proportion to their degree of curvature. This made it difficult to set forms and obtain a uniform subgrade. A considerable amount of hand work was necessary in shaping the subgrade. The concrete was hand tamped and struck off with heavy strike boards.

A tamping machine was not used because very frequent changes were necessary in the surface of the concrete, running from a crown section, to flat and crown, and then to a flat section, also the varying width of the surfacing due to the curve widening.

Immediately after the base course was placed, a wood form was clamped to the 6-in. steel form and the integral curb 1½-in. thick, and 6 in. wide was placed with material consisting of a 1:2:3½ mix. The base course of concrete was then roughened with a small corrugated roller weighing about 100 lbs., pulled back and forth between the curbs at an angle of 45°. This was then cross rolled making small 2-in. squares in the concrete.

The Kentucky rock asphalt was placed 2½ ins. loose and rolled down to 1½ ins. which made it flush with the concrete curb on the sides. The average run for a day of ten hours in placing concrete was 735 lin. ft. or about 1300 sq. yds. The average run for a

day of ten hours in placing asphalt was 900 lin. ft. or about 1500 sq. yds. The surfacing was begun April 17 and finished October 29.

Gulf Beach Highway, Pensacola, Florida

By W. E. WHEAT
COUNTY ENGINEER

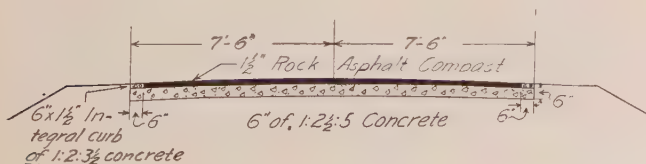
The "Gulf Beach Highway," built of concrete in the past two seasons by Speed-Parker, Inc., Louisville, Ky., connects Pensacola, Florida, with the beach on the Gulf of Mexico. This work was done as a part of a two million dollar county road paving program. The highway provides access to the Gulf Beach without crossing water—a feature not to be found elsewhere on the Gulf coast between Galveston, Texas, and Cedar Keys, Florida. The Highway itself is 12¾ miles long, paved of reinforced concrete throughout, 18 ft. wide. All structures larger than 18 in. opening are of concrete. Bridges are of deck girder construction with abutments on pile foundations.

The design of the highway was dictated largely by past experience with concrete roads in this county, principally the one between Pensacola and the U. S. Military and Naval Reservation. That road, laid during the early months of the World War, took a tremendous, war-time traffic and practically all the cracks which have developed to date have been on the center line. No shattering of edges has been experienced. The design was a non-reinforced 6 in. to 7 in. to 6 in. slab, 18 ft. wide, of 1:2:4 mixture using a small gravel. It is doubtful whether a 2,000-lb. strength concrete was secured. The sub-grade was sand, identical with that on the Gulf Beach highway, which joins that road.

For the Gulf Beach highway the design used was a 5½ in. to 7½ in. to 5½ in. slab, 18 ft. wide, expansion joints every 30 ft. Reinforcing consisted of 44-lb. galvanized steel wire mesh, laid 2 in. from top of slab and ¾-in. steel bars laid 4 ins. on each side of expansion joints. The mixture used varied with the size of aggregate, in order to obtain a concrete of not less than 3,000-lb. compressive strength per sq. in. 6 in. x 12 in. test cylinders were taken from the work frequently and broken for data upon which to control the mixture, which was proportioned in accordance with "Abram's Method" with most gratifying results.

The only practicable method of hauling material was by industrial railway and this method was used by the contractors. The loading plant consisted of a trestle about 200 ft. long with a wooden tunnel through which the batch box trains were run for loading with aggregate. The cement storage shed accommodated about four carloads. Average haul of material was 6 miles, the project being 12¾ miles long, and the storage plant ¾ miles from beginning of project. This was necessitated by railway connections.

The average day's work over the whole period of construction, including shut-downs amounted to 163 lin. ft. per day. The maximum day's work was 450 lin. ft. The low average was due in part to the railway strike and bad weather; the major factor being insufficient rolling stock—3 locomotives and 72 batch cars of two batch boxes each comprised the rolling stock of the contractors. The mixing was done with a Foote 21E steam paver for about ½ the length of roadway, when the contractor installed a gasoline motor-driven



SECTION OF BARBOURVILLE-PINEVILLE ROAD

FIG. 1—GULF BEACH
HIGHWAY, PENSACOLA,
FLORIDA

FIG. 2—THE ROAD UN-
DER CONSTRUCTION



paver of the same size and make, finding it more economical on account of the heavy hauling charge on coal. Finishing was done by Lakewood mechanical finisher. C. W. Douglas was resident engineer in charge.

Form Costs Corrected

An apparently innocent little editorial paragraph of only eight lines appeared in the October issue of CONCRETE, in the nature of comment on our progress in efficiency in connection with form work. The principle involved still stands. Unfortunately the figures given were not correct. On checking up with the contractor who inspired this editorial paragraph, we find that the figures should have been as follows: For the erection of flat slab complete, labor only, $3\frac{1}{2}$ to $3\frac{3}{4}$ ¢ per sq. ft., instead of $2\frac{1}{2}$ to $2\frac{2}{3}$ ¢ per sq. ft. Our contractor friend advised us that he is actually erecting flat slab forms, labor only, for $3\frac{1}{2}$ to $3\frac{3}{4}$ ¢ per sq. ft., whereas years ago with 30¢ labor it cost just the same. The difference is due, he tells us, to the standardization of methods so that there are no lost motions, and also to using old hands who are thoroughly familiar with the work and are selected for their activity and industry and paid a bonus for exerting themselves. The complete cost, not including materials, is as follows:

	Per sq. ft.
Wood floor forms—making...	.0278
Erecting complete.....	.0375
Stripping.....	.0163
Making the complete work... making, erecting and stripping.	.0816

We hope that several readers of CONCRETE who very kindly called attention to our obvious error, one or two of them registering indignation in the publication of such an item, will find these figures check up fairly well with their own experience.

The point it was designed to make, so far as principle goes, remains: that with labor at 30¢ per hour and with labor at \$1.10 per hour, the labor cost remains the same for a given work; this indicating the increased efficiency and skill over a period of years.

New Standards for Concrete Road Construction, by Committee C-6, and a paper describing important changes of road construction practice, for higher quality concrete, will be presented at the American Concrete Institute Convention, Chicago, Feb. 25-28.

Taking the Hand Saw Away From the Form Carpenters

BY NELSON L. PROTHEROE

The appeal written on the face of "The Successful Bidder," the framed picture of a contractor agonizing over the award of the contract of which he is the awardee, is further enhanced by his exclamation: "I wonder what I forgot!"

Doubtless, as low man, he either did forget something or else had a few original ideas up his well worn sleeve when he figured the job and which he intended to marshal forth in the event he got the contract. Now, with the word to go ahead, he begins to think of a number of things. Economy in the expenditure of labor becomes his chief thought. Potentially, materials have already been bought and paid for and sub-contractors awarded their bits.

In concrete construction the building of forms, both as to methods and costs, can either be a fixed item—followed without change by leaving the whole matter up to the carpenter foreman, trusting to his

ability to make the men under him "get up in the collar"—or one made amenable to definite savings.

Under the following method, in the words of Mark Twain, it is possible to make one blade of grass grow where but two grew before. In other words, where it has been thought advisable to place 60 carpenters on a given project, 25 average men will be all that are needed. There is no theory in that. It has been worked out and proved true. To illustrate good form methods to those who have not given form building all the thought it should have, the accompanying drawings are made to represent good ideas that have been gathered and grouped together and which, if followed, will mean that along with worn wheelbarrows and pieces of rope, real dollars may be counted up at the end of the job as part of the profits.

The plan comprises the one thought: Make all forms at the field mill. The essential requirements for the

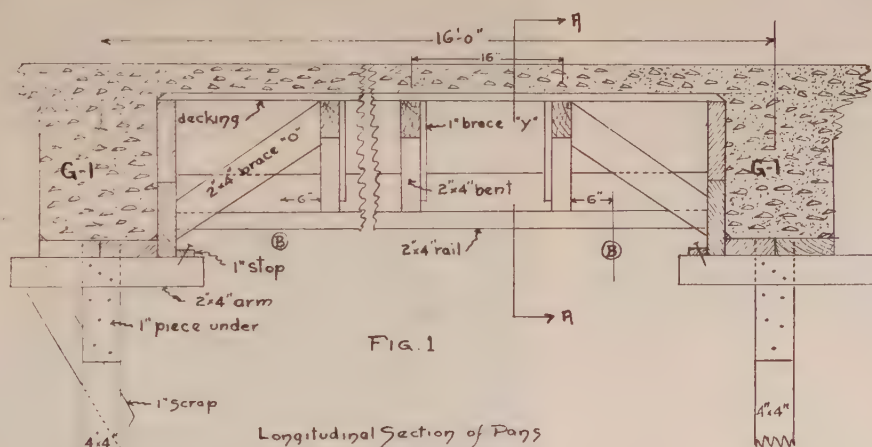
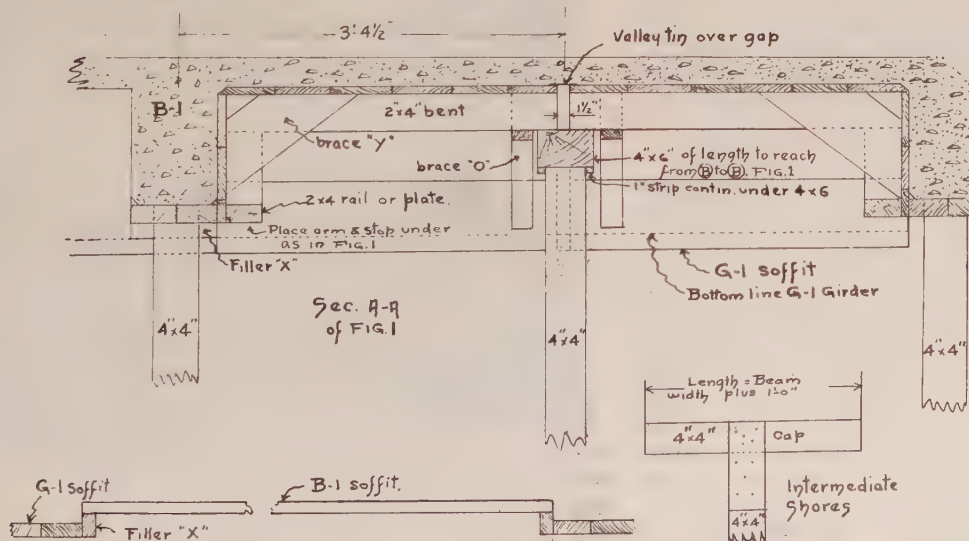


FIG. 1—DETAILS SHOWING THE MANNER IN WHICH WOODEN PANS WERE USED IN THE CONSTRUCTION OF REINFORCED CONCRETE MILL BUILDINGS

THE WAY IN WHICH
RE-SHORING OF BEAMS
AND FLOOR PANELS CAN
BE DISPENSED WITH
AFTER FORMS ARE SET
IN ALSO SHOWN



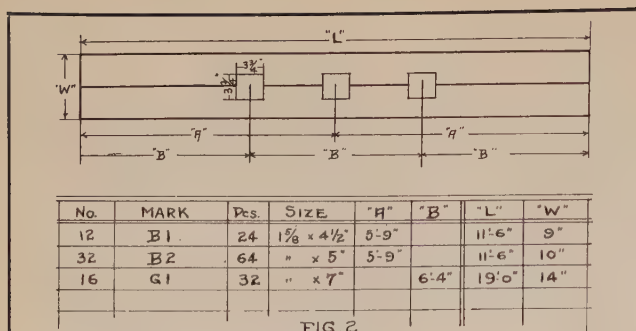


FIG. 2—METHOD OF DETAILING BEAM AND GIRDER SOFFITS BY THE MILL MAN

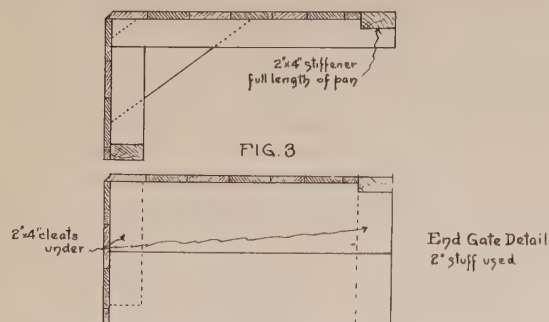


FIG. 3—DETAILS OF 2 x 4 RAIL STIFFENER WHERE FORMS ARE TO BE USED A NUMBER OF TIMES

mill are: one 6-ft. swinging cut-off saw, a rip saw and table, and, if necessary, a band saw. Only special kinds of forms require the last.

In the field office, put to work a good draftsman who thoroughly understands drawings and understands something about carpenter work and who has a personal regard for a 2x4 and a piece of sheathing. Let him detail the forms before the carpenters are hired for the job. The draftsman's cutting lists, showing the sizes of material the form parts are to be cut from, should be used in the ordering of lumber. The mill man and his helper, working from a blue print copy of the cuttings lists, will then use only the predetermined sizes and lengths the various form parts were meant to be cut from.

When enough material has been cut up to warrant it, put on a few carpenters to assemble the form parts. While that work is going on let the mill turn out all shores as shown in Fig. 1. The shores, as in regular practice, are to be wedged from the floor. The job, then, being ready for the forms, is also ready for more carpenters—about half the number at first thought of. Using a setting diagram previously got out, the carpenter foreman starts setting the forms correspondingly marked on the benches near the mill, the carpenters under him using little else than hammers and bars.

Adopting a concrete building of beam and girder construction to illustrate (method used recently in the erection of a flour mill), Fig. 1 shows the manner in which wooden "pans" were used. The "pans" were made with a view for repeated use. The oftener the sets can be used, of course, the cheaper the cost per square foot of form work for the entire job will be. And the initial cost of a floor set ought not, after the men are acquainted with their work, exceed a like cost per square foot where forms are built in place in the old manner for each floor. The method under consideration has these advantages: It cuts down the number of men on the payroll; saves in the estimated appropriation for lumber; prevents waste through indiscriminate cutting and re-cutting; uses all available scrap

lumber; and is capable of cutting in half the cost of form building.

Fig. 1 will also show how re-shoring of beams and floor panels can be dispensed with after forms are stripped. The removing of forms may be done earlier under this method as shores, either one or two, depending upon the lengths of spans, are left undisturbed after form stripping. It will be noticed that those shores intended to remain have their heads cut into the soffit boards to the concrete lines of the beams and girders.

In making out the cutting lists detail the shortest pieces first. Then follow with other pieces in order of next lengths. That permits the mill man to use up the maximum amount of short pieces—a big item in saving lumber.

When piling cut material on the platform near the mill, pile them according to lengths. The men assembling the forms at the benches will know without hesitation where to go in order to find a needed piece. Mark the top piece of each pile, and allow that piece to be the last of its kind used up.

In detailing column form sides permit them to rise in height only to the underside of the beam or girder soffit line. The ends and sides of the pans, with necessary angles built in, will act as the extension to the floor line.

Use 8d. common nails instead of 6ds. on all sheathing. That will mean less repairs.



FIG. 4—COLUMN FORMS AND BEAM FORMS BEING SET FOR BUILDINGS OF HYDRO-ELECTRIC PLANT NEAR MONTREAL

FIG. 5—SLIPPING COLUMN FORMS FOR EXTENSION

FIG. 6—FIRST FLOOR FORMS PLACED WITHOUT THE AID OF HAND SAWS

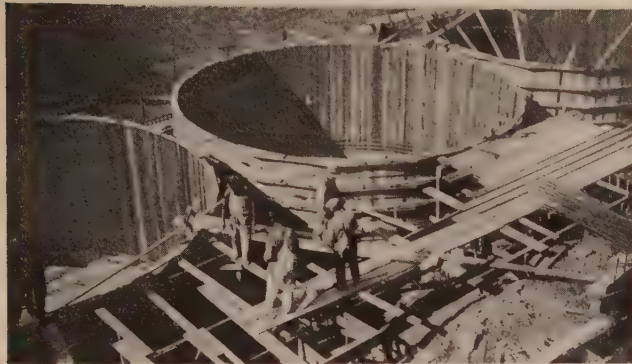
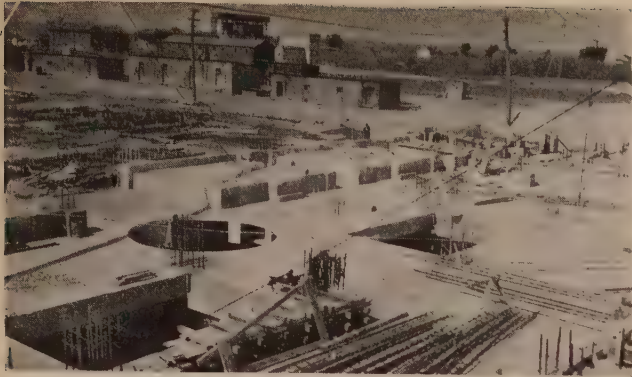


FIG. 7—FIRST FLOOR STRIPPED OF FORMS

FIG. 8—OUTSIDE FORMS FOR CONCRETE PERCOLATING TANKS IN PLACE AT THE TINTIC STANDARD MILL AT GOSHEN, UTAH

Where forms are to be used a number of times, construct them with a 2 x 4 rail as shown in Fig. 3. It will also be found desirable to coat the forms with paraffin oil the first time. None of the forms shown need to be battered. They will readily strip themselves. In stripping they are not to be dropped, but shouldered down by carpenters working from planks laid across the shore lacing.

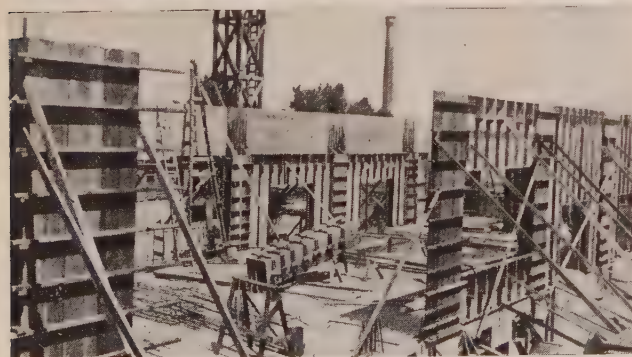


FIG. 9—SETTING THE UNIT FORMS FOR THE CONCRETE BASE OF FURNACES

FIG. 10—PRE-BUILT FORMS BEING SET IN CONSTRUCTION OF FLOUR MILL AT DENVER, COLO.

Fig. 2 shows how the beam and girder soffits are detailed to the mill man. All soffits are split, and are to be notched as shown for the supports left standing after the forms are taken down.

Forms for flat slab construction have also been made under this plan of building at a great saving over the old method.

Figs. 4, 5, 6 and 7 illustrate the construction of a hydro-electric plant near Montreal. The buildings in which the writer's first attempt in carrying out the idea described in this article was made were constructed by the Unit Construction Co., St. Louis. The writer was head carpenter foreman and all the forms were detailed and made a mile away from the site of the buildings.

Figs. 8 and 9 are views of the Tintic Standard mill, erected at Goshen, Utah, on which construction job the writer was superintendent; Villadsen Bros., Salt Lake City, were the contractors. The job was especially receptive for a systematic method for building forms. Work was started early in 1920 and completed in December of the same year. Fig. 8 shows the outside forms for the concrete percolating tanks in place and prepared for the reinforcing before the inside forms were to be set. The forms for the inside and outside were made in arc sections of about 6 ft. A band saw

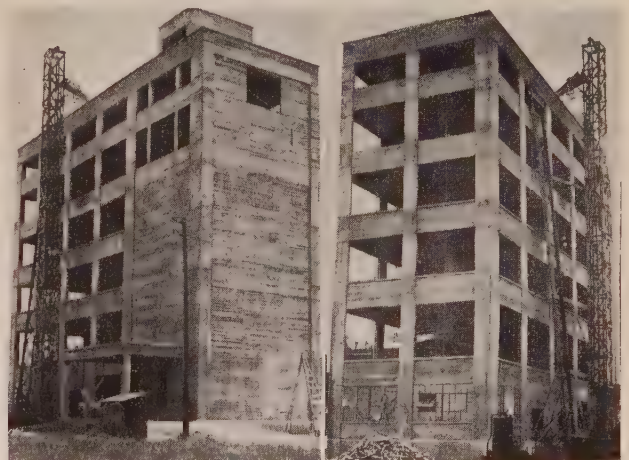


FIG. 11—VIEWS SHOWING THE CONDITION OF MILL BUILDING THREE MONTHS AFTER EXCAVATION WORK WAS BEGUN

was used in cutting out the radius boards to which the sheathing was nailed. The form sections were held together by cleating them with scabs cut to the same radius. In setting the unit forms for the concrete base of the furnaces shown in Fig. 9, no hand saws were used except for cutting 2 x 4 bracing.

Fig. 10 shows pre-built forms being set for construction of a flour mill at Denver, Colo., for the Farmers' Union Milling and Elevator Co. The construction work was done by the Lynch-Cannon Eng. & Constr. Co. Salt Lake City, and was under direct charge of the writer in 1921. Fig. 11 shows the condition of the mill building 3 months after excavation was begun. A maximum of 12 carpenters worked on the job and plans used in the construction of this building are detailed in the drawings reproduced in Figs. 1, 2 and 3.

"Whitewash and Cold Water Paint" is the title of an interesting 8-page bulletin put out by the National Lime Association. It describes the mixture for various purposes and how to apply them.



FIG. 1—CONCRETE STAVE SILO, PERDUE UNIVERSITY EXPERIMENTAL FARM, NEAR BEDFORD, IND., BUILT IN 1923 BY THE CEMENT PRODUCTS CO., WORTHINGTON, IND.

Concrete Silo Stave Manufacturers' Annual Convention

The Eighth Annual Meeting of the National Concrete Stave Silo Association, held in Chicago, December 4-5, was unquestionably the best in the history of the organization. Whereas in previous meetings the discussions were centered around advertising and merchandising, this year's program stressed the manufacturing side of the business. The manner in which the manufacturers followed the lectures and demonstrations covering recent developments in producing quality concrete was a revelation. It goes to show that there exists a real desire among manufacturers to put into practice processes that will either increase the efficiency of their plants or improve the qualities of their products.

The technical side of the program was opened by Prof. H. F. Gonnerman of the Structural Materials Research Laboratory, Lewis Institute. First he gave a brief review of the important investigations under way at that Institution where 35 trained men, working under the direction of Prof. D. A. Abrams, are making an intensive study of the fundamentals of concrete mixtures to determine what things affect strength, durability and other desirable properties in concrete. Then he pointed out how the quality of concrete could be improved by putting the findings of these investigations into practical use. By means of charts, tables and exhibits, he showed how the strength and other properties of concrete were affected by the

structural strength and cleanness of the aggregate, by the quantity of mixing water, the quantity of cement, the grading and size of the aggregates, time and manner of mixing and the conditions under which the concrete is cured. A number of pans of aggregate of different gradings were exhibited, as were the screens for making the sieve analysis and the cone for making the slump test.

The practical applications of the laboratory investigations were further brought out by E. W. Dienhart of the Portland Cement Association. In the last year, Mr. Dienhart has been in charge of a number of concrete products investigations in Philadelphia, Prairie du Chien, Wis., Des Moines and Milwaukee. In the research work done at Philadelphia, 27 different types of brick were made. Each lot represented different kinds and gradings of aggregate, was made with varying proportions of cement and aggregate and different amounts of mixing water. The brick were made under actual operating conditions, using the equipment found in the plant and employing the regular workmen. Compression and absorption tests were made on the various kinds of brick at different ages. The results of these tests confirm the findings of the Structural Materials Research Laboratory and show that it is possible for manufacturers to produce concrete products of a desired strength by proper manipulation of such factors as selecting and grading the aggregate, regulating consistency, time of mixing, etc.

The effect of the grading of aggregate on the strength of concrete brick was emphasized by giving the comparative strength of three lots of brick, each made with a 1:5 mixture of cement to aggregate. The first lot was made with aggregate having a fineness modulus of 1.67 and developed a compressive strength of 835 lbs. per sq. in. at 28 days. The second lot was made with aggregate having a fineness modulus of 3.0 and required a load of 1980 lbs. per sq. in. to crush. Brick in the second lot were slightly rougher in appearance than those in the first lot. The use of the coarser material more than doubled the strength of the brick. In order to determine to what extent coarse aggregate could be expected to increase the strength of the brick, one lot was made up with aggregate so coarse that it produced a brick of such rough texture as to be unsaleable. Brick from this lot, however, developed a surprising strength of 3540 lbs. per sq. in.

At Prairie du Chien, Wis., some tests were made on concrete building tile which were produced in the plant of the Prairie Concrete Products Co. In these investigations it was discovered that by using aggregates of a certain grading, the cost of producing tile could be reduced \$6 per thousand and still have the desired strength.

Right in line with the discussions by Messrs. Dienhart and Gonnerman was the progress report of the committee on Concrete Staves. This committee has been working on the preparation of standard specifications in order to secure data on which to base specifications that would be fair and reasonable and so decided to make a number of tests on concrete staves submitted by manufacturers in different sections of the country. The results of four tests are shown in the accompanying table. Each manufacturer submitted six staves for testing and average results are indicated. The transverse test was made by applying a concentrated load at the center of the stave laid flatwise in the testing machine and supported at both ends, the distance between supports being exactly 24 inches. This test is of extreme importance because it indicates the ability of the staves to resist the horizontal pressure of silage, grain, coal or whatever other material is stored in the

structure. The compression test was made on sections approximately 6 inches long and 6 inches wide by the thickness of the stave cut out from the stave after the transverse test. The transverse strength is expressed as pounds per inch of width. This is done because the different types of staves vary somewhat in width. However, the majority of the staves tested so far were 10 inches wide and the actual total breaking load can be computed by multiplying the load per inch of width by 10. The surprising thing about tests is the low rate of absorption, in no instance going over 5% and in one case as low as 2.8%.

TESTS OF SILO STAVES WHEN 28 DAYS OLD

Lot No.	Time of Mixing	Aggregate		Mix	Compressive Strength lbs. per sq. in.	Transverse Strength lbs. per in. of width	Absorption Per cent by weight 48 hours
		Kind	Fineness Modulus				
7080	1 min.	Sand	2.32	1:3	2540	48	4.9
7107	3 min.	Sand	2.84	1:3	3310	128	2.8
7109	2 min.	Sand	2.72	1:4	1900	75	3.7
7123	4 min.	Sand	2.94	1:3	1680	92	4.2

D. R. Collins, Secretary of the Wisconsin Concrete Products Association, gave an inspiring talk on the accomplishments of that organization. It has made an enviable record of progress during the last year. Mr. Collins gave as his reasons for this achievement the formulation of a definite program of work and the loyal cooperation of every member in carrying out the activities decided upon. The program for the past year included:

- 1. Bettering the quality of concrete products.

- 2. Giving concrete products publicity through the press.
- 3. Working with architects, contractors and builders to show them the merits of concrete structural units.
- 4. A monthly bulletin containing news items of members and suggestions on merchandising, advertising and manufacturing.
- 5. The regular testing of products with a view to securing certificates of quality.
- 6. The promotion of concrete masonry units for the walls as well as for foundations of residences.
- 7. A direct mail advertising campaign.

The silo business during the past year was a decided improvement over 1922 and the prospects for 1924 appear very bright. These facts were uncovered in a number of five minute talks by representatives from different states. Present indications point to an increase of at least 50 % in the silo business in 1924 over 1923. The Madison Cement Stave Silo Co. built the most silos during the past season, completing a total of 711. The Michigan Silo Co. was a close second with 683. M. B. Fry of the firm of Neff and Fry, formerly vice president of the Association, was elected president for the coming year. He succeeded W. B. Trost, president of the Waterloo Concrete Corporation, Waterloo, Ia. Mr. Fry's company is specializing in the erection of concrete stave coal pockets and has built several hundred of these labor-saving, coal handling plants. H. A. Fraser of the Rib-Stone Silo & Crib Co., Joliet, Ill., was elected vice-president. W. G. Kaiser was reelected secretary-treasurer.

Laying Linoleum on Concrete or Wood Floors

The most satisfactory way to lay linoleum or cork carpet over concrete or wood according to manufacturers of linoleum is to put it down over a layer of heavy felt paper. The joints should be sealed with waterproof cement. Ordinary gray unsaturated building or deadening felt, weighing not less than 1½ lbs. per sq. yd. should be used, it being first pasted to the floor and the linoleum pasted to the felt with all seams and edges glued down with waterproof cement. Laid in this manner, the manufacturers claim linoleum will wear a long time and retain its resiliency. There will be no trouble from buckling or shrinking. The work of laying can be done expeditiously, no retrimming being required.

According to specifications issued by the Armstrong Cork Co., the linoleum, when brought onto the job, should not be unrolled until it has been subjected continuously to a temperature not less than 70° F. for at least 48 hours. Provision should be made for maintaining a temperature of 70° F. in all locations where linoleum is being laid from the time unrolling is begun until the completion of the job.

All refuse consisting of plaster, dust and other dirt should be removed from the floor and the surface cleaned thoroughly before starting work. The floor should be perfectly dry and smooth before laying the linoleum.

For laying linoleum on concrete, it is recommended that the material be cemented firmly to a concrete

base, either with or without a lining of deadening felt. A lining of deadening felt adds to the quietness and resiliency of the linoleum floor, and makes possible the cutting and fitting of better seams. The felt lining does, however, add something to the cost of the floor and while that is an important factor, it can be omitted.

Another very important point to note is that the use of linoleum is never recommended on concrete



FIG. 1—APPLYING THE PASTE TO THE FELT. ONLY THE SPACE ALONG THE EDGES OF THE LINOLEUM AT SEAMS AND ENDS OF STRIPS IS LEFT UNCOATED. THE MARGINS ALONG THE EDGES ARE LATER COATED WITH THE WATERPROOF CEMENT



FIG. 2—CUTTING THROUGH BOTH EDGES OF PLAIN LINOLEUM AFTER A $\frac{1}{2}$ -IN. LAP HAS BEEN ALLOWED, TO PROVIDE TIGHT FITTING, BUTTED JOINTS



FIG. 3—SEALING SEAMS OF TWO ADJOINING STRIPS OF LINOLEUM WITH WATERPROOF CEMENT

that is not thoroughly seasoned, or on any floor that is in direct contact with the ground. Linoleum has practically no capillary action and moisture cannot be absorbed through it. Moisture that happens to be in the concrete, therefore, collects on the under surface of the linoleum and in time gives trouble.

Where a lining of deadening felt is used, sufficient supply should be obtained to cover the whole area on which the linoleum is to be laid. A good linoleum paste for cementing the felt to the floor is necessary and enough should be applied to paste the main area of the linoleum to the felt. In addition, a small supply of waterproof cement is necessary for gluing down the seams and edges.

After cutting the felt in suitable lengths a good coat of paste should be applied to the back of the felt which should then be smoothly and accurately fitted to the base and the entire surface rolled thoroughly with a 150-lb. iron roller. The same process should be repeated on each width in turn. The edges of the felt should be butted carefully and no ridges should be left under the linoleum. The felt should be laid across the short way of the room in most cases, so that in putting the linoleum the long way of the room the seams in the felt will be at right angles to the seams in the linoleum.

At least 24 hours should be allowed after the felt has been pasted in place and before the linoleum is laid. The entire surface should be swept clean to provide a clean and smooth surface next to the linoleum.

The linoleum should be accurately fitted to the walls and around all pipes and other projections in the floor. Paste is then applied to the surface of the felt in sufficient quantities to insure firm adhesion except for a space about 4 in. wide at those points where the edges and joints of the linoleum fall. These spaces are left bare for the later application of the waterproof linoleum cement. Fig. 1 shows the method recom-

mended for applying the paste which cements the linoleum to the underlying felt or to the floor if no felt is used. Immediately after the paste is applied to the felt, the linoleum should be placed in position and the surface rolled thoroughly with a 150-lb. roller until all air blisters are rolled out. Where printed and inlaid linoleum are to be used, all seams should be made tight by butting the edge of the several strips snugly together, care being taken to preserve the symmetry of the pattern. The seams in plain, battleship, granite and jaspes linoleum and cork carpet should be made tight by lapping the edges of the several strips approximately $\frac{1}{2}$ in. when pasting them to the under layer of felt and later cutting through both thicknesses simultaneously with a sharp knife. This action is illustrated in Fig. 2.

All seams, edges and joints in the linoleum should be lifted and the waterproof cement applied thickly to the surface of felt or floor as far back under the linoleum as the edge of the coating of paste. The cemented edges of the linoleum should be pressed firmly into place and thoroughly rolled until the surface is smooth and even. All seams and edges and joints must be weighted down with pressed brick, sand bags or other suitable weights for not less than 24 hours. Any cement coming in contact with the surface of the linoleum should be removed with alcohol at once. After the cement has set the weights should be removed and all debris or dirt cleaned from the surface.

FIG. 4—ROLLING THE LINOLEUM WITH 150-LB. ROLLER TO REMOVE BUBBLES AND IRREGULARITIES BEFORE WEIGHTING DOWN THE SEAMS AND EDGES WITH BRICK OR SAND BAGS OR OTHER WEIGHTS



The 20th Anniversary Convention of the American Concrete Institute at the Drake Hotel, Chicago, Feb. 25 to 28, will give one day to a program in review and celebration of 20 years of progress.

Flow Through Concrete and Other Culvert Pipes

By C. E. DeLeuw
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Design of culverts with due regard for their hydraulic properties has seldom been attempted in the past. The ever increasing scale of labor and material costs is causing the designing engineer to make a more critical examination and analysis of his designs of all structures. Culvert designs have generally been made on the basis of waterway opening required without regard to the effect of friction losses of different materials upon the velocity of flow. In the last few years there has been an increasing amount of discussion of friction losses as well as other hydraulic factors which affect the capacity of culverts.

THE IOWA EXPERIMENTS

A comprehensive investigation on the flow of water through pipe culverts was conducted at the hydraulic laboratory of the State University of Iowa during the summer of 1922. Tests were made on commercial corrugated metal pipe of 12-, 18-, 24- and 30-in. diameter. To determine the effect of the length of the culvert on flow, the 24-in. pipe was tested in 24-, 30- and 36-ft. lengths. The other sizes were tested in 30-ft. lengths only. The number of tests (almost 1,000) warrant considerable confidence in the results obtained. The experiments were conducted by D. L. Yarnell, Senior Drainage Engineer, Bureau of Public Roads, U. S. Department of Agriculture, and Sherman M. Woodward and Floyd A. Nagler, Professor and Associate Professor, respectively, of Department of Mechanics and Hydraulics, State University of Iowa.

These investigators made a study of a number of hydraulic factors in culvert design such as entrance losses for different types of entrances, effect of carrying elevations and culvert and the coefficient of roughness "n" in Kutter's formula. From these experiments, the following average values of the coefficient of roughness were found.

Diameter of Pipe Inches	Kutter Co efficient Corrugated Metal Pipe
12	0.019
18	0.022
24	0.022
30	0.023

EARLIER TESTS

These results check with the somewhat meager data obtained prior to these tests for corrugated metal pipe. In 1913, Cone, Trimble and Jones conducted tests on a semi-circular corrugated metal flume having an arc length of 132 in. and a total length of 1,745 ft. The coefficient of roughness ("n") obtained varied from 0.0196 to 0.027, depending upon whether the flow was measured on a tangent or on a curve. In 1917, the Bureau of Public Roads conducted tests on 8-in. and 10-in. corrugated metal pipe 200 ft. in length. The coefficient of roughness ("n") obtained for the pipe flowing full varied from 0.017 to 0.021.

There is an abundance of data available on the values of "n" for concrete pipe. Many tests have been made not only in the laboratory, but also in the field, on structures of great length and built under varying conditions.

TABLE I—DISCHARGE OF PIPE CULVERTS ON A ONE PER CENT. GRADIENT

Internal Diameter of Pipe Inches	Water Area in Square Feet	Discharge of Corrugated Metal Pipe in Cubic Feet per Second	Discharge of Concrete Pipe in Cubic Feet per Second	Carrying Capacity of Concrete over Corrugated Metal Pipe Percent
12	0.79	1.83	3.40	86
15	1.23	3.44	6.35	85
18	1.77	5.70	10.17	79
24	3.14	12.70	22.78	79
30	4.91	23.60	41.73	77
36	7.07	39.10	68.22	75
42	9.62	59.45	102.93	73
48	12.57	85.84	147.44	72
54	15.90	118.14	201.61	71
60	19.64	157.91	267.30	69

DATA FROM BUREAU OF PUBLIC ROADS

The Bureau of Public Roads of the United States Department of Agriculture published Bulletin 852 on "The Flow of Water in Concrete Pipe" in 1920 which contains the data gathered from a great many tests. Many of these data were from the records of the U. S. Reclamation Service and also from the leading consulting engineers in many sections of the United States and Canada. Tests of many existing concrete pipe lines, including the Victoria, B. C., Aqueduct which is 42 in. in internal diameter and 27 miles in length, are presented. This Bulletin is the most complete and authoritative work on the value of the coefficient of roughness for concrete pipe. After reviewing all data presented, the following suggestions are made for "n" in Kutter's Formula:

- Class 1. (Old California cement pipe lines.)
 - n=0.013 for pipes up to 10 in. in diameter.
 - n=0.014 for pipes from 12 to 24 in. in diameter.
 - n=0.015 for pipes from 26 to 42 in. in diameter.
- Class 2. (Modern "dry-mix" concrete pipe and monolithic concrete pipe or tunnel linings made over rough wood forms.)
 - n=0.013 for pipes up to 36 in. in diameter.
- Class 3. (Small "wet-mix" pipe in short units; "dry-mix" pipes in long units; average monolithic pipe made on steel forms.)
 - n=0.012 for pipes up to 24 in. in diameter.
 - n=0.013 for pipes more than 24 in. in diameter.
- Class 4. (Glazed—interior pipe lines; monolithic pipe lines where all interior surface irregularities are removed—only highest grade of workmanship and materials.)
 - n=0.011 for pipes from 12 to 24 in. in diameter.
 - n=0.0115 for pipes from 26 to 28 in. in diameter.
 - n=0.012 for pipes more than 30 in. in diameter.

COMPARISONS BETWEEN CONCRETE AND CORRUGATED METAL PIPE

It will be noted that the coefficient of roughness increases with the increase in diameter of both concrete and corrugated metal pipe. For the purpose of making a comparison, however, this slight variation has been neglected. In order to compare the carrying capacities, Table I has been prepared showing the capacity of various sizes of pipe. For concrete pipe, a value of "n"=0.013 is used, because the character of workmanship and finish of a culvert is not generally of as high a grade as in sewer construction. Reference to the above table of values, suggested in Bureau of Public Roads Bulletin 852, will indicate that this value of "n" gives a proper factor of safety. For corrugated metal pipe, a value of n=0.021 is used. The pipes are figured as flowing full. The entrance and velocity losses are disregarded as they are practically the same for each material with a given type of entrance.

Similar computations were made for pipe culverts of the same materials on different gradients and show that the percentage of comparative capacity is independent of the gradient. The practical application of these data in highway construction is apparent. It can be seen readily that a 12-in. concrete pipe can be substituted for the 15-in. corrugated metal pipe, a 15-in. concrete pipe for an 18-in. corrugated metal pipe, the substitutions continuing in the same proportion as the diameter of the pipe increases.

Courtesy, Municipal and County Engineering.

Contracts for Unlimited Quantities

BY EUGENE K. STURGIS
OAKLAND, CALIFORNIA, BAR

When a bidder undertakes to supply a certain quantity of material under specifications which permit the government to take more or less than the amount designated in the bid, such a contract is void for lack of mutuality and consideration.

Such is the decision of the United States Supreme Court handed down recently with relation to a contract for coal for the Navy, but which may be applied to all dealers in materials. It is also of particular interest to all dealers in materials offered for sale to the government.

While these contracts have been commonly used by federal, state and municipal governments in the letting of awards for supplies, it is now held by the court that they are worthless, and may result in a complete change in the form of contracts to be used hereafter.

The cases in question involve deliveries of coal to the Navy Department. It seems that in the spring of 1916 this department called for bids in the form of a schedule, containing specifications and conditions on printed forms of proposals. Among other items it called for delivery of 600,000 tons of coal to be delivered at Hampton Roads, Virginia, and permitted dealers to bid on the entire or less than the entire quantity specified. One clause of the specifications provided as follows:

Quantities estimated.—It shall be distinctly understood and agreed that it is the intention of the contract that the contractor shall furnish and deliver any quantity of the coal specified which may be needed for the naval service at the places named during the period from July 1, 1916, to June 30, 1917, irrespective of the estimated quantities stated, the government not being obligated to order any specific quantity. The estimated quantities have been arrived at from records of previous purchases. While they represent the best information obtainable as to the quantities which will be required . . . they are estimated only and are not to be considered as having any bearing upon the quantity which the government may order under the contract.

Toward the end of the year for which the bid was given, the government demanded of the bidders that they supply 10% more coal than the bid called for. One of the bidders had agreed to furnish 10,000 tons—the other 200,000 tons, and the government called upon them for 11,000 and 220,000 tons respectively. At the conclusion of lengthy negotiations, the dealers supplied the 10% additional demanded by the government, under protest, claiming to reserve to themselves any right to recover for the difference between the contract price and the market price. The contract price was \$2.85 per ton, and the market price at the time of delivery was \$6.50 per ton, this making a considerable amount of money involved where the quantities were so appreciable. The dealer who had agreed to furnish the 10,000 tons protested against supplying the additional 10% on the ground that its obligations under the contract were met by having supplied the 10,000 tons. They offered, however, to supply the balance demanded reserving the right to collect the difference between the contract and market price later. The department would not agree to this but again demanded the additional 10% without further correspondence, the dealers did so, and then sued.

The dealer who had agreed to supply 200,000 tons protested against supplying an additional 10% on the ground of shortage in coal supply relieved it of such liability. The Navy Department did not accede to

this proposition and the dealer then supplied the additional 10%.

It should be noted that in both instances the dealers supplied the coal demanded, although protesting, undoubtedly with the advice of counsel, that they were under no liability so to do. If they had adhered to their positions, and refused to deliver the coal demanded they would not, as will be seen hereafter, have suffered any loss.

The Supreme Court held that the contracts were not enforceable, for lack of consideration and mutuality, because there was nothing in the writing to compel the government to take or limit its demand to any ascertainable quantity. This is in effect to holding that if the dealer had chosen so to do he need not have supplied the additional 10% tonnage demanded. It was also held that while the contract at its inception was not enforceable, it became valid and binding to the extent that it was performed. In this connection the Supreme Court said—

There was no duress or compulsory taking. The recent order was given and prior orders had been given with reference to the contract

The correspondence shows that the department (Navy) declined to accept the dealers view and refused to entertain its request or proposals of leaving the matter of price open. . . . The dealers failed further to object and delivered the coal. It is not important whether it was persuaded that the department's interpretation of the writing was correct or to avoid controversy decided to fill the order. Its earlier protest is of no avail, and it must be held voluntarily to have accepted the order for the additional tons and to have furnished it at the price specified in the contract.

In other words, the Supreme Court holds that such a contract is not enforceable, but that if the dealer chooses to accede to the demands of the government under such conditions he binds himself to the provisions of the bid which he has made.

In this case failure to stand by the refusal to deliver the excess, lost the dealer in one case the sum of \$3,650.00 and in the other case the sum of \$73,964.48. It should be noted that specifications of a large number of government agencies, including states, counties and cities call for bids for supplies with such a clause in the specifications as is quoted above. Dealers who bid under such contracts are fully entitled to insist that they be not compelled to deliver more than the amount bid upon in the contract even though suit is threatened by the authorities.

This becomes particularly important in certain cases, as in the case under consideration, when the market price varies greatly between the time of entering into the contract and the time of the delivery of the materials the bidder agrees to supply. It would even seem that these decisions permit the dealer to refuse to deliver under such contracts if he finds that such delivery will not be advantageous to him. If the contract is not enforceable at its inception and is valid and binding, only to the extent that it is performed, as the Court holds in the cases under consideration, then the dealer can refuse further delivery at any time it suits his convenience.

The two decisions under consideration are of far reaching importance to all dealers in supplies of any sort who are in the habit of bidding under such specifications. They may have the effect of eliminating this type of contract altogether, and of compelling the various governmental agencies to purchase always in the open market at market prices. Certainly the decisions are very favorable to the dealer, because they hold that he is not obliged to supply materials under the contract at all. A logical corollary to this is that the dealer can refuse to supply materials at any time it becomes inconvenient for him so to do, inasmuch as the contract is binding to the extent that it is performed.

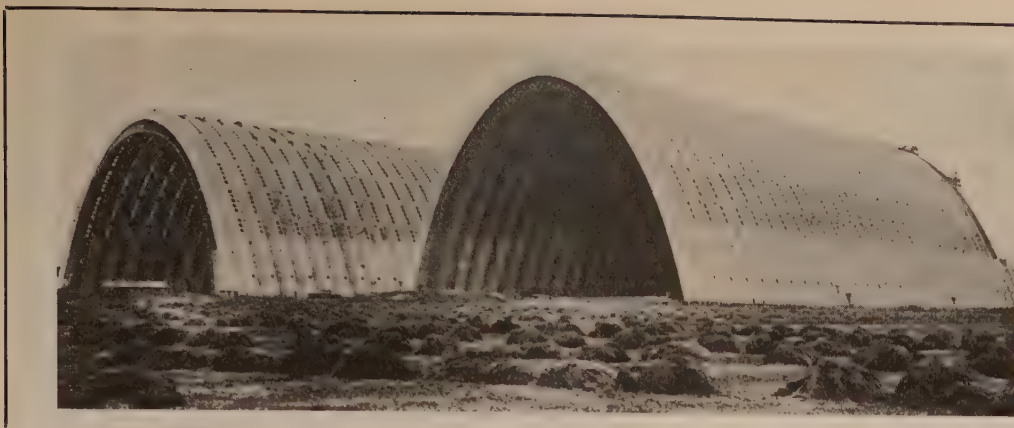


FIG. 1—REINFORCED CONCRETE HANGARS AT ORLY, FRANCE, FOR HOUSING DIRIGIBLES

(Photo by Underwood & Underwood)

Housing a Blimp in Reinforced Concrete

BY FREDERICK M. DELANO, JR.
PARIS, FRANCE

Two monster dirigible hangars constructed entirely of concrete are being completed at Orly, France, near the aviation school of Captain Nungesser. Each of these two vast structures measures 300 meters (nearly 1000 ft.) in length, 59.3 meters (about 196 ft.) in height, and 91 meters (about 300 ft.) across at the base. Seen from the road in the Bois de Vincennes, as one drives in from the historic Marne, the two buildings loom like giant eggs protruding about half way out of the ground, some 15 miles off across country, for their general shape is like the sharper end of a hen's egg.

The government called for bids and plans to be submitted on the specifications it gave out for the enterprise, and those drawn up by M. Freyssinet were accepted. These were adjudged by the committee to be the most practical, simple, and, at the same time, the most economical. The idea was simply a long arch of corrugated appearance, closed at both ends by huge metal doors swinging outwards.

Due to the constitution of the soil, which was argillous and compact, and the lack of a heavy pressure over the entire surface, a simple foundation of reinforced concrete under each side of the hangars was found to be sufficient. A trench was dug the full length of each side—300 meters long, 2 meters deep, and 7.85 meters (about 25 ft.) wide. In each of these trenches a slab of reinforced concrete was poured, and this 3-ft. slab supports the superstructure. The braces protruding from this foundation form the "liaison" between it and the hangar walls. The construction of the foundations is shown in Fig. 2.

The next step in this work of pouring the concrete shell was to build the base of the hangar walls to a height of about 1 meter above the soil, in that peculiar zigzagging form adopted for the arches—giving the hangars, as completed, the appearance of great accordions.

These sections of "accordion pleats" are referred to by the French as "Zores elements." When the constructors had completed the first stage of the walls, by a simple process of building the molds, placing the reinforcing steel, and pouring the concrete—working from the ground—they turned to the problem of erecting the second stage, which was to be 17 meters (about 55 ft.) high. Here began the originality of construction which has made this job stand out from all others in the world.

On the inner side of the hangar walls, and parallel to them for their entire length, rails were laid, on which a platform of reinforced concrete was placed on rollers which allowed it to be moved the length of the hangar. On this platform a wood scaffolding 18 meters high was erected, surmounted by a derrick. The scaffolding was made universally mobile, transverse motion being provided for by means of rollers on the platform.

The scaffolding carried the interior mold for the concrete, the mold being just the size of a "Zores element." The exterior mold was movable in pieces, which were built up for each pouring with the aid of the derrick, after the reinforcement and braces had been put in place. The mold being entirely built up, it remained only to pour the concrete. After the concrete had hardened, the interior mold was rolled back on its movable scaffolding, the exterior pieces were taken down, and the whole platform moved forward 7.50 meters, the length of one "Zores element," or segment. After moving up the platform again, the same operation was repeated.

In building the last part of the arch, which is actually superimposed upon the two first stages of the walls, the same method of constructing one segment of arch at a time was followed; but here another problem had to be



FIG. 2—FOUNDATION TRENCH OF ORLY HANGAR. REINFORCING RODS BEING PLACED READY FOR POURING CONCRETE

FIG. 4—RAISING THE 30-TON KEY TO POSITION IN THE ARCH MOLD

met—that of withdrawing the mold from *under* the arch instead of away from the side. Following the idea of economy still, the method employed was simple and cheap.

For the semi-circular mold required, a very strong arch was necessary. This arch-mold was constructed on the ground, in three pieces—the key, which weighed 30 tons, and the two sides, each weighing 45 tons. The lower ends of the sides were made of beams of reinforced concrete which, during the construction of the rest of the semi-circle, rested on two supports of reinforced concrete, on which they could roll without sliding.

The lateral arches when finished rested on the provisional supports and on wooden horses which had been used to hold them during construction. About 24 meters (79 ft.) from the rotation girder, screw-jacks, resting on the ground and working in pairs, were braced at an angle of 60°. With these jacks the lateral arches were raised by steps of about 4 ft. As soon as possible sheers were placed under the arch segments, and the segments raised to their proper positions by these

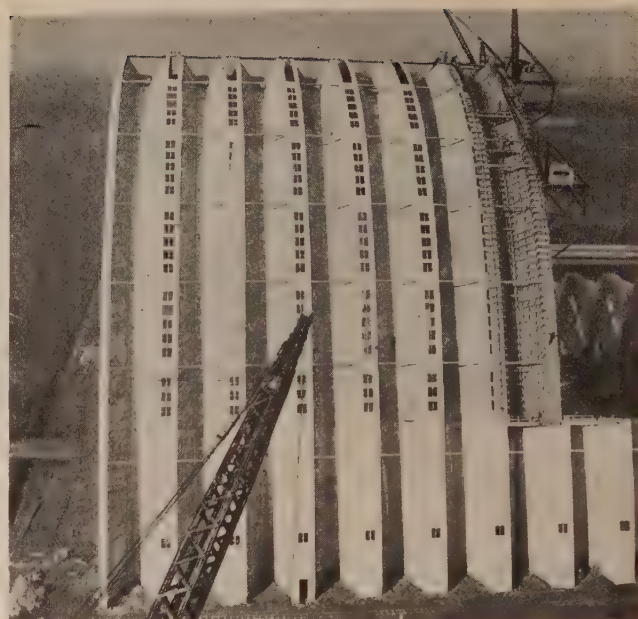


FIG. 6—VIEW FROM TOP OF ONE HANGAR. IN FOREGROUND, ALL-WOOD DERRICK BUILT ON PREMISES TO SAVE COST AND TIME

jack, which raised the girder 1.85 meters (about 6 ft.) at a time. Thus the arch-mold could be raised and lowered on both sides at the same time in a perfectly level position.

As the jack would only raise the girder 6 ft., it was necessary to work by stages, holding the arch base in its semi-raised position until the jack could be lowered again and something placed underneath the girder to give new purchase. By placing timbers in the holes in the uprights, *AAA*, Fig. 5, the girder could be locked in place and 4 timbers placed between the head of the

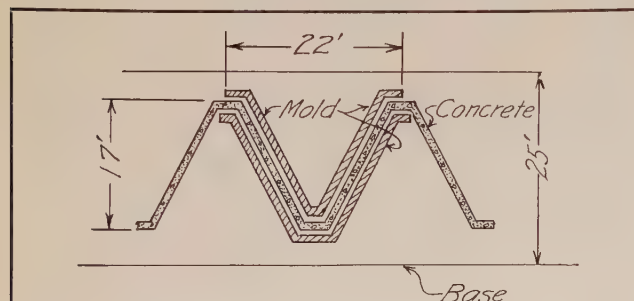


FIG. 3—DIAGRAM OF CROSS SECTION, SHOWING FORMATION OF "ZORES ELEMENTS"

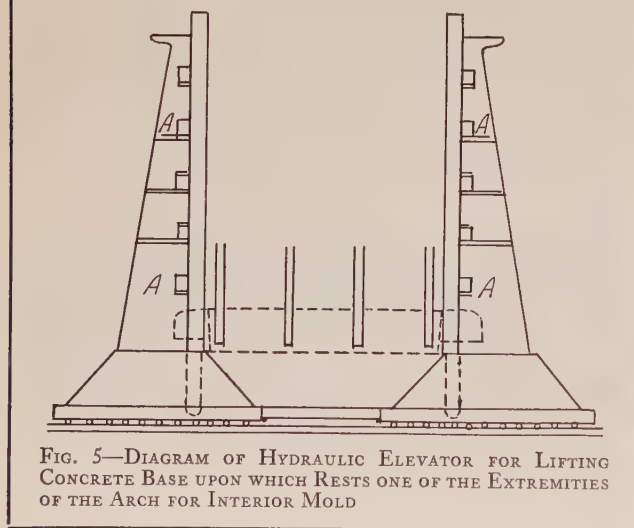


FIG. 5—DIAGRAM OF HYDRAULIC ELEVATOR FOR LIFTING CONCRETE BASE UPON WHICH RESTS ONE OF THE EXTREMITIES OF THE ARCH FOR INTERIOR MOLD

sheers of varying length. Once these two lower parts were in place, they served as derricks, by which the key part of the arch-mold was raised into place, as shown in Fig. 4.

To remove the mold from under the concrete arch after the concrete had hardened, this arch-mold had to be lowered out of place. The bases of the arch were therefore placed on elevators, which allowed for a movement of 11 meters (about 35 ft.) up and down. These elevators were constructed of two pieces raised opposite each other, about 15 ft. apart, on a large concrete platform resting on rollers. Each upright piece was grooved vertically, and in this groove ran the ends of the girder on which the arch actually rested. At the base of each groove was a hydraulic



FIG. 7—RUNWAYS HANGING FROM TOP OF HANGAR

FIG. 8—GENERAL INTERIOR VIEW, SHOWING AT FAR END THE DOORWAYS BEING PUT IN. THE ACTUAL DOORS WILL BE SHEET METAL, SWINGING OUTWARD ON LITTLE TRACKS AND MOVED BY MACHINERY



FIG. 9—WRECKAGE OF PLANE AND TOOL HOUSE IN HANGAR, WHEN PLANE DIVED THROUGH NETWORK OF WIRES INTO CONCRETE WALL. THIS SHOWS, BY COMPARISON, THE SIZE OF THE "ZORES ELEMENTS" AT THE BASE

jack and the girder, thus elongating lift of the jack by 6 ft.

With the inner mold in place, and with the aid of derricks built on the arch itself, the outer mold pieces could be raised and assembled and held together by bolts. The planking of the mold was strong enough to hold an interior pressure of about 13,000 lb. to the square meter. To hold the inner and outer molds at the proper distance apart, octagonal concrete blocks were made, with hollow cores. By placing these in the mold at intervals, and passing bolts through them, the thickness of the mold at any one place could be regulated and the bolts removed without difficulty after the concrete had hardened. Following this process of work, including letting the concrete harden and dismounting the mold again, the time required per segment was seven days. Every Monday regularly the advance was made—one segment forward.

Each of these segments is 7.50 meters (about 24 ft.) wide, from the center of one key to the next, and 15 ft. deep, there being 40 of them to each hangar. At the ridge of the hangar the thickness of the concrete on the sides of the segment is only 9 cm., and 20 cm. on the tops and bottoms; while at the lower part of the hangar walls the thickness runs to 34 cm. The hangars are strengthened by horizontal brace beams running from one gable to the other, which prevent possible distortion by wind action.

An interesting thing about the economical method of work is that practically every piece of equipment, windlass, derrick, etc., was built from wood or concrete. The cranes on the arch-mold are entirely of wood.

The hangar is lighted by 2,428 square windows of yellow mica or glass, placed in the outer ridges of the segments. There is also a system of ventilation which allows the gases and bad air to escape but no water to run in through the concrete ventilators, which are placed at the tops of the structures. In order to have access to all parts of the dirigibles which will be housed there, five rails for trolleys have been placed at the intrados of the arch, and runways of reinforced concrete, are suspended from the tops of the hangars. To get to these runways, stairways of concrete are built in the four wings of the doorways, which are hollow.

Cinder Concrete Units Fire and Water Test

Abstract of a report by Prof. Albin H. Beyer of three hour fire and water test made upon two partitions built of precast reinforced cinder concrete units erected by the Non-Burnable Building Products Co., Inc., Yonkers, N. Y.

Two partitions built of precast reinforced cinder concrete units were erected by the Non-Burnable Building Products Co., Inc., of Yonkers, New York, and subjected to a 3-hr. fire and water test covering tests of fireproof partition construction at the Columbia University Fire Testing Station, in accordance with the rules of the New York State Industrial Code. Aside from the development of vertical cracks which appeared during the first half hour of the fire test, a decided permanent warping or inward deflection of the partitions and a slight calcination of the inner surfaces sufficient in places to expose the wire mesh reinforcement, the specimens were in good condition after the tests.

The partition test-house was built and the test made in accordance with Rule 509 of Bulletin No. 7 of the State Industrial Code, the requirements of which are identical with those of the Rules and Regulations of the Bureau of Buildings of New York city.

PURPOSE AND OUTLINE OF TEST

The purpose of the fire proof partition test was to determine the effect of a continuous 3-hr. fire against the test partitions, which are required to be representative of the material and workmanship obtained in common practice.

The requirements of the State Industrial Code, include the following:

The construction to be tested shall be subjected for three hours to the continuous heat of a fire, rising in temperature to 1700° F. by the end of the first half hour, and maintained at an average temperature of 1700° F. for the balance of the test; the fuel used being either wood, gas, oil, or other fuel, so introduced as to cause an even distribution of the heat throughout the test structure. * * *

The temperature obtained shall be measured by means of standard pyrometers. * * *

The temperature should be measured near the center of the test structure about 6 in. below the roof or ceiling and also at the center of each partition under test about 7 ft. above the grate level. * * *

At the end of the fire test, a stream of water shall be directed against the construction under test, discharged through a 1½-in. nozzle, under 30 lbs. nozzle pressure for 2½ minutes, the nozzle being held within 2 ft. of the firing door and the hose stream being played backward and forward over the entire fire side surface of the partition under test. * * *

The test shall not be regarded as successful unless the following conditions are met; no fire or a considerable volume of smoke shall pass through the partition during the fire test; the partition must safely sustain the pressure of the hose stream; the approval of the construction under test may be withheld if the partitions should warp or bulge to an extent deemed dangerous by the Industrial Board.

DESCRIPTION OF TEST PARTITIONS

Both test partitions were built of reinforced cinder concrete precast slabs constructed and erected as shown in Fig. 1. Each slab was reinforced with a sheet of wire mesh, about 28 in. wide, extending the full length of each precast slab. This reinforcement was folded lengthwise back upon itself so as to form a flat U with a 1¼-in. space between the two 13-in. legs.

The longitudinal wires of the wire mesh were 0.090 to 0.100 in. in diameter, spaced 1¼ to 1⅜ in. o. c. The transverse wires were .053 in. in diameter, spaced 2 in. center to center. All steel reinforcement was galvanized. The center portion of the wire mesh reinforcement for a width of 9 in. was completely filled and covered with cinder concrete, thus giving a



FIG. 1 (LEFT)—REINFORCED CINDER CONCRETE SLABS. SHOWING METHOD OF ERECTING PARTITIONS



FIG. 2 (RIGHT)—INTERIOR VIEW OF TEST HOUSE SHOWING 1 3/4-IN. UNPLASTERED PARTITION



FIG. 3 (LEFT)—UNPLASTERED 1 3/4-IN. TEST PARTITION. VIEW TAKEN 24 HOURS AFTER TEST. NOTE REINFORCEMENT EXPOSED AT JOINTS. FOR COMPARISON OF CONDITION BEFORE TEST, SEE FIG. 2

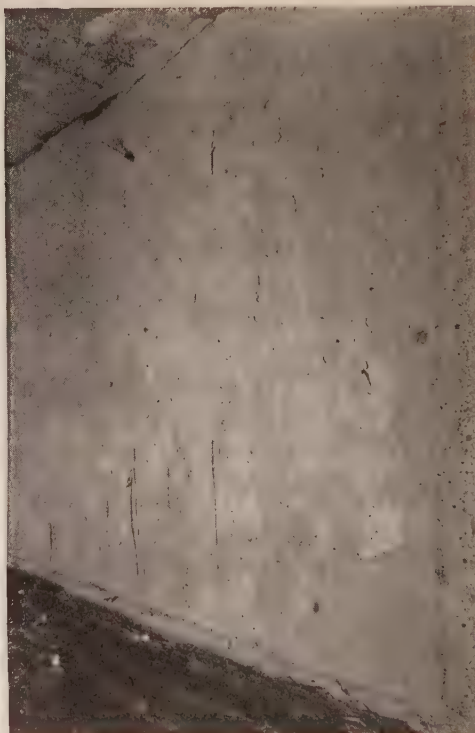


FIG. 4 (RIGHT)—PLASTERED 2 1/2 IN. TEST PARTITION. VIEW TAKEN 24 HOURS AFTER THE TEST SHOWING THE CONDITION OF SIDE OF THE PARTITION EXPOSED DIRECTLY TO THE FIRE AND WATER. NOTE SCALING OF MORTAR COAT AND EXPOSED REINFORCEMENT IN SEVERAL PLACES

concrete board 9 in. wide, 1 3/4 in. thick, with the reinforcement projecting 2 in. on each side and covered in the body of the slab with about 1/4 in. of concrete. The cinder used in molding the slabs was mixed in the proportion by volume of one part of portland cement, 2 parts of sand and 3 1/2 parts of cinders.

The planks were erected in a vertical position with a laying width of 12 in. which gave, at the joints, an overlap of 1 in. for the steel reinforcement.

ONE AND THREE-QUARTERS INCH UNPLASTERED PARTITION

In the partition which constituted the east side of the partition house, 14 of the precast slabs, each 9 ft. long, were erected in a vertical position. At the top, at each joint, these slabs were secured to the test house

by two 20-d nails driven into the test house through the wire mesh, and clinched around it. At the bottom, the planks were fastened directly to a steel angle, which formed a part of the test structure. The spaces between the planks about 3 in. wide, were filled, using trowels, with mortar mixed in the proportion of 1 part by volume of portland cement, 1 1/2 parts of sand, 1 1/2 parts of cinders and 1/8 parts of lime. All joints were finished by floating. Fig. 2 shows the inside face of the unplastered partition.

TWO AND ONE-HALF INCH SOLID PLASTERED PARTITION

This partition constituted the west wall of the test house. It was built and erected in the same manner as the 1 3/4-in. unplastered partition, except that the joints were filled and both surfaces of the partition

CONCRETE

coated with mortar mixed in the proportion of 1 part portland cement, 3 parts of sand and $\frac{1}{8}$ parts of hydrated lime. The mortar coats varied from $\frac{3}{8}$ to $\frac{1}{2}$ in. in thickness, producing solid partitions $2\frac{1}{2}$ to $2\frac{3}{4}$ in. thick.

TEMPERATURES

The temperatures of the furnace were obtained by means of three rare metal thermo-couples, and the frequency of firing was governed by the temperature of the furnace; dry wood in 4-ft. lengths was used as fuel.

The temperature of the outside surface of each partition was recorded by mercury thermometers reading to 1000° F.

The deflections of the partitions were measured at regular intervals at the quarter points and center of each partition, using as a reference line to measure from, a fine wire stretched horizontally across each partition at a height of 40 in. above the level of the firing grate.

EFFECT OF THE FIRE

The fire was ignited at 1:26 p. m., May 16, 1923. The furnace temperature rose slowly due to the wet condition of the walls of the test house. An attempt had been made in the last 24 hours previous to the test to dry out the test partitions with artificial heat, but the time was too short to accomplish this.

At 1:29 and again at 1:33, some of the plaster on the fire side of the plastered wall spalled off with popping sounds. At 1:32 when the temperature of the furnace was 1043° F., both test partitions were giving off considerable quantities of steam. Three vertical cracks had started to open on the plastered partition and one vertical crack had formed at the northerly end of the unplastered partition. Steam and hot water, issuing from these cracks called attention to them. When the free water was driven out of the partitions, these cracks became less noticeable. Pronounced inward deflections of the two test partitions developed from the very beginning of the test, amounting in 30 minutes to a maximum of 1.86 in. for the unplastered partition and 2.76 in. for the plastered partition.

At 1:45 p. m. some of the plastered joints on the fire side of the east wall scaled with a popping sound. Seven minutes later a second vertical crack developed in the south end of the east test partition.

At 2 p. m.—34 minutes after the fire was lit, an average furnace temperature of 1702° F. was reached. Through the open fire door it was seen that most of the scaling of the mortar coat on the fire side of the west or plastered partition had taken place in the lower half of the partition. No further appreciable scaling of the plaster took place after the first half hour.

At 2 p. m. practically all of the free water had been driven out of the test partitions and the mercurial thermometers which recorded the temperature of the exposed surface of the test partitions began to rise rapidly above 210° F.

During the second half hour the furnace temperature averaged 1695° F. and the temperature of the surface of the partition increased from 210° F. to 417° F. for the unplastered partition and from 210° to 296° F. for the plastered partition. The inward deflections also increased to 2.07 in. and 2.90 in., respectively.

During the second hour of the test, the furnace temperature averaged 1722° F. The surface temperature of the east partition increased during this period from 417° to 850° F. At 3:10 p. m., when the thermometer read 738° F. a yellow pine chip resting directly

against the east wall below the thermometer ignited and burst into flame. The surface temperature of the west wall increased in the same time from 296° to 624° F.

During the last hour of the test the furnace temperature averaged 1748° F. The east partition reached a maximum surface temperature of 976° F. and the west partition a maximum surface temperature of 788° F. At 4:07 p. m., when the surface temperature of the west partition was 749° F., a yellow pine chip resting against the partition ignited and burst into flame.

The maximum deflection for the east partition, amounting to 2.56 in. occurred at 3.50 p. m. The west partition deflected its maximum, namely 3.23 in., at 3:30 p. m.

APPLICATION OF WATER

At 4:33 p. m., a stream of water from $1\frac{1}{8}$ -in. nozzle was directed against each partition for two and one-half minutes under a nozzle pressure of 30 lbs. per sq. in. The water was applied through the door and struck the partitions at an angle. The nozzle was held as close to the door as the heat of the furnace permitted and the stream of water was played back and forth over the whole surface of the partition and not allowed to play continuously over any one spot.

PHYSICAL EFFECT OF FIRE AND WATER TEST ON PARTITIONS

The following effects of the fire and water test were noted:

Several of the vertical joints in the unplastered partition where exposed to the fire, scaled in places, thereby exposing some of the wire mesh reinforcement.

The precast cinder concrete slabs, except for a small amount of calcination of the concrete on the side exposed to the fire, were in good condition.

The surface of the unplastered partition, not exposed directly to the fire, was in very good condition; the two vertical cracks which had developed in the first half hour of the fire test had closed up appreciably 2 days after the test.

The principal effect of the fire upon this partition was the decided permanent warping or inward deflection; this amounted, 48 hours after the test, to 2.10 in.

The side of the plastered partition exposed to the fire showed some scaling of the rough mortar coat sufficient in several places to expose the reinforcement in the joints between the slabs. Only a small portion of the area of the partition was thus affected. The exterior surface of this partition was in exceptionally good condition; the three vertical cracks 24 hrs. after the test, were barely visible. The chief effect of the fire and water test upon this plastered partition was the resultant permanent warping or inward deflection which was found to be 2.65 in. two days after the test.

A 125,000 Capacity Brick Plant at Newark

A plant for the Port Newark Brick Co., Newark, N. J., is under construction and being equipped with 16 Peerless brick machines to give a daily capacity of 125,000 common sand-cement brick. The company is headed by William D. Decker, Newark, president of the Decker Building Material Co., who has always contracted for the entire output of the plant covering a period of five years.

The contract calls for completion of the plant by January 1, 1924. L. V. Thayre as vice president and general manager and Napoleon A. Worthington will be in charge. The plant has two and one-half acres of water front property at Port Newark, with 200 ft. of docking facilities and a 35-ft. depth. An overhead rail train is to be used to deliver sand direct from the scows to the mixing rooms and reserve bins, while the rail facilities are such that cars of cement and other supplies are delivered from the main lines into the plant without rehandling.

Cast Concrete Piling Supports Bearing Wall

An ingenious method for taking care of unstable soil conditions and to prevent possible settlement was used in the construction of the foundations of the Universal school, now being built at Universal, Pa. The site was selected because its elevation afforded a maximum of good air and light, and also because it was located near a reinforced concrete road.

Prior to beginning of excavation, the usual test borings were made. An investigation showed that coal had been taken from beneath the site many years ago, and that unless this condition was properly cared for, settlement of the bearing walls might occur. This was taken into consideration in the design of the footings, but it was deemed advisable to take even further precautions.

After careful study of the situation, it was decided that, instead of driving piles, it would be better to really cast what might be termed concrete piles to carry the bearing or load-carrying walls. The building is approximately 60 ft. by 90 ft. in plan. A total of 42 holes, each 10 in. in diameter and ranging in depth from 42 to 54 ft., were drilled from 9 to 12 ft. apart directly beneath the bearing walls. Drilling was carried to hard pan. The classification of the excavation is shown on the accompanying sketch.

The holes were filled with concrete, after which each was covered with a concrete cap 12 in. thick and 16 in. square. Undoubtedly there were fissures or crevices in the earth which had to be filled with concrete, as for holes of the same diameter and the same depth there was a variation in some instances of close to 40% in the amount of concrete required to fill them.

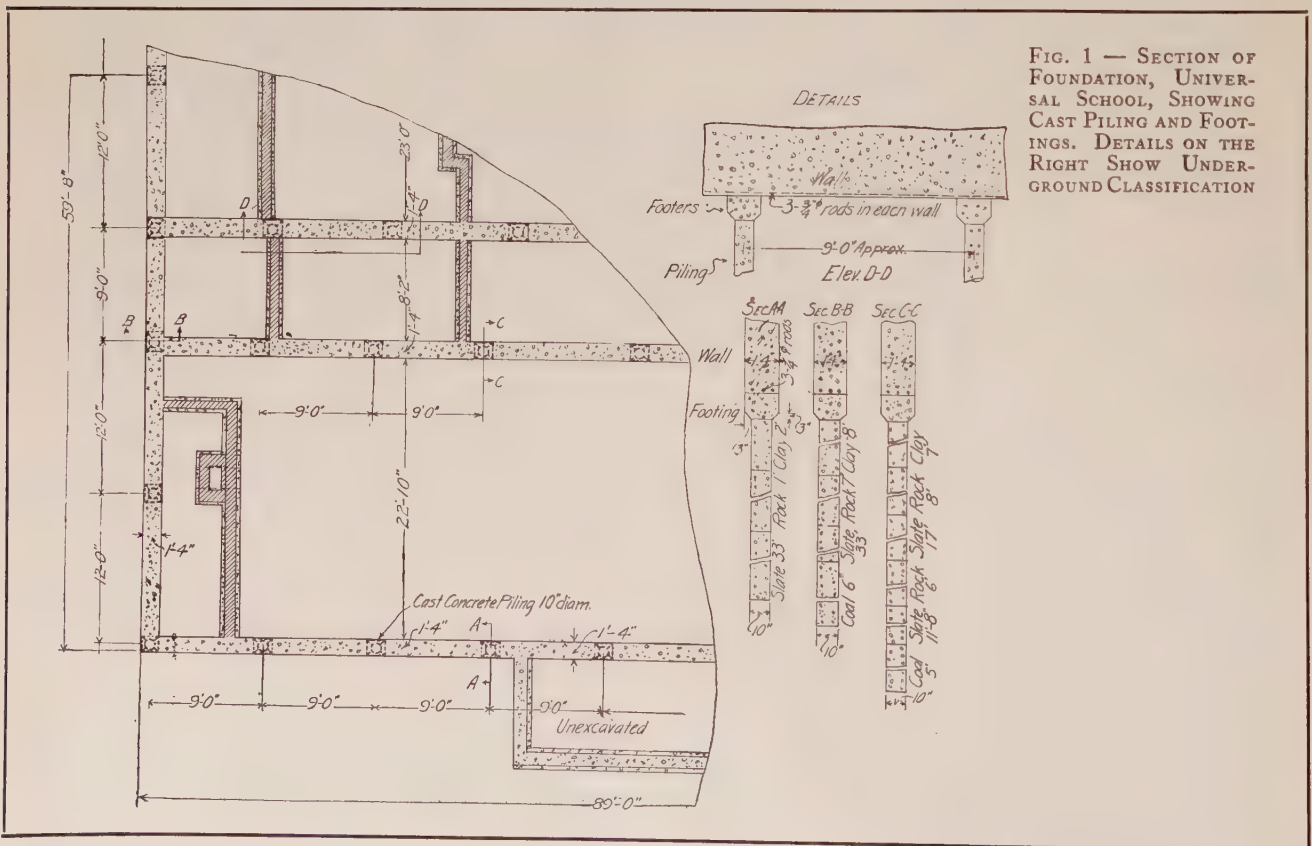
The bearing walls are carried directly on the caps. Three $\frac{3}{4}$ -in. round rods were placed longitudinally near

the bottom of the walls to provide for beam action between the piles. Frequent checking of elevations since construction began indicates no settlement has taken place.

The school building of concrete construction throughout, including foundation walls, floors, roof, and portland cement stucco exterior walls—was designed by Ingham & Boyd, Architects, Pittsburgh, Pa. Construction is being carried on by the J. G. Fullman Co., Pittsburgh, Pa., under the supervision of the architects.

Difficulties in Winter Public Work

With the object of discussing the further possibilities of reducing winter unemployment in the construction field, there was a meeting of the Philadelphia Building Congress in Philadelphia, October 31. It seems that at this time there is some relief of the tension in the building program and there are prospects of a return to seasonal unemployment. In the 20 schools which the Board of Education has placed under contract there, only two have been completed. Other schools are anywhere from one to nine months behind the schedule. There appear to be unsurmountable difficulties in the way of hastening public work in keeping such public work going in winter under our present statutes. The chief difficulty perhaps is the fact that payment is only made for work which is in place. There is thus no incentive for a contractor to accumulate stocks of materials which insure continuous operation. Another influencing factor is the fact that the penalty in the contract is only twenty-dollars a day, which means that a man could lose two hundred days or an equivalent of an entire year at a cost of only four thousand dollars, which on an eight hundred thousand dollar job is not very much, providing he can effect a saving in labor or in materials by this delay.



Twin Trail Highway Construction

Twin trail highway construction which has recently originated in Canada and which is being used in London, Ont., substitutes for the wide pavement, two relatively narrow strips of concrete, each about 18 to 24 in. wide. The crown and haunches of the road are formed of cheaper and less durable material, such as gravel or water-bound macadam. The main feature of the twin trail construction lies in the means employed for prevention of ruts which would ordinarily form at the edges of the strips in the softer materials of the crown and haunches.

The sides of the strips are formed of a continuous series of triangular projections as shown in the accompanying illustrations. These meet so that a series of triangular projections are formed in the gravel when the gravel is in place and packed in hard by the traffic over-running the strips.

The same form of edging is suggested for application to a pavement which extends part way or completely across the road and which is provided with shoulders of different material. Springbank Drive which was officially opened by the Minister of Highways for Ontario in September is a road 30 ft. wide and 27 ft. between shoulders; two 10-ft. concrete slabs are separated by a 7-ft. gravel center for horse drawn vehicles. The saw-edge idea for connecting the gravel or broken stone with the concrete making a bond between the two, was applied on this stretch of highway.

The forms for the saw edges are made on 8-in. plank with the triangular pieces cut from 6-in. square blocks, two pieces from every block. These nailed on the upper side of the 8-in. plank form a saw tooth edge 6 in. deep, while the concrete is 8 in., running into a full width slab at the bottom 2 in. under the saw tooth edges. Enough forms for the performance of a day's work is all that is required. The forms remove easily from the concrete and it is claimed that the saw tooth edges stand up well in comparison with a straight edge.

The twin trail system is recommended by its inventor, Robert Greene, London, Ont., for use where highway authorities must exercise care in spending money for new hard surface roads and when all users of roads are clamoring for improvement in their own particular locality. It is claimed that the twin trail permits, for the same cost, 5 miles for one of 20-ft. wide concrete roadway. The twin trails are recommended for any road where the great percentage of the travel is straight-away.

It is suggested that on a road leaving a city, four pairs of trails could be used; the two outside trails for the slow moving traffic, and the two inside for the more rapid travel, leaving a good space in the center between the two inside trails. A road 40 ft. wide and four pairs of trails thereon would use up only 12 ft. wide of concrete paving or 8 cu. ft. of concrete for each lineal ft. of roadway. The material used between the trails would be held in place and not be crowded to the side of the road by traffic, thus cutting down the cost of the up-keep. Everything put on the road would be packed down, creating a hard durable roadway and the level of the trails would become the level of the whole road.

It is cited in favor of the twin trails that there is far more danger of a car running off the pavement with a straight edge than in running off the trails as



FIG. 1—THE LONDON TO SPRINGBANK DRIVE UNDER CONSTRUCTION SHOWING THE SERRATED EDGING AS EMPLOYED IN THE TWIN TRAIL SYSTEM

in going off the pavement the right wheel gets down into a rut and meets resistance and the left wheel is perfectly free to swing around on the pavement and a turn-over is possible. With the trail, the two wheels both right and left are off the trail at the same time

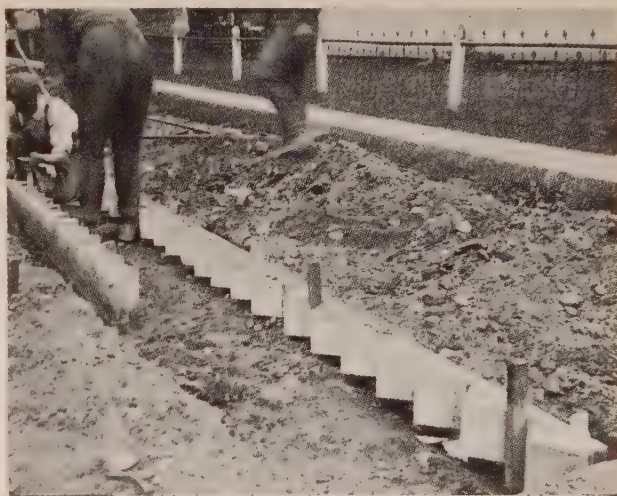


FIG. 2—FITTING FORMS FOR TWIN TRAIL ROAD CONSTRUCTION

FIG. 3—TWIN TRAILS AFTER THE CONCRETE HAS BEEN POURED AND READY FOR THE GRAVEL FILL BETWEEN TRAILS AND ON THE SHOULDERS

and the same resistance or about the same will be on each wheel. Therefore the steering will not be difficult. With the trails, it is claimed, there is not the flow of water to the edge, such as there is on the wide pavement and the trail being united to the road surface by the saw tooth edge, the danger is eliminated.

The twin trail system was patented in 1921 by Robert Greene and the serrated edging was first incorporated in the plans of Charles Talbot, county engineer, on the London to Springbank Drive.

Standard Concrete Mixer Plates

The accompanying illustration shows a sample of the plates which will designate to contractors, the rating and maximum capacity of standard size concrete mixers as adopted by the Joint Committee on Equipment in Chicago, July 30. The plates were designed and adopted at the request of the manufacturers in order to avoid any misrepresentation, over-rating, or under-rating of mixers. Complete standardization is to be achieved before January, 1925.

Three types of paving mixers are designated as 21-E, 13-E, 12-E, and 7-E. Either the 12-E or the 13-E is to be omitted according to results of a referendum to members of the Associated General Contractors relative to the preferable size. Five types of building mixers are designated as 28-S, 21-S, 14-S, 7-S and 5-S.

Each plate gives the number of cubic feet of concrete per batch for the various mixers and the number of bags of cement to which the mixer is adapted. The maximum capacity of the paving mixers is based on 40% voids in aggregate and one gallon of water per cu. ft. of mixed concrete. The building mixers, give the maximum capacity based upon 40% voids in aggregate and 1½ gallons of water per cu. ft. of mixed concrete.

The largest paving mixer No. 21-E is for a 6-bag batch with proportions 1:1½:3 or a 3-bag batch with proportions 1:3:6. The smallest paving mixer, 7-E is for a 1-bag batch.

The capacities of the building mixers range from the ½-bag size for a 1:3:6 mix to the largest size, 28-S which is for an 8-bag batch with proportions 1:1½:3 or a 4-bag batch with proportions 1:3:6.

Applying the Top Coat to Concrete Floors

BY NELSON L. PROTHEROE
DENVER, COLORADO

The following method for placing the topping on concrete floors is not proposed as being entirely original in all details, yet numerous inquiries and discussions have disclosed but one instance where engineers, architects or contractors have carried it out as an important factor in the making of a good floor. To the contractor, the saving comes in the elimination of finishers' overtime, and the owner has a better building.

Often specifications are written to require the placing of floor topping—usually of a 1:2 mix—on the base immediately after the base has been poured to insure a bond—essentially the monolithic method. That is in most cases a troublesome requirement. And especially in the construction of a building which is to have numerous floors of concrete it anticipates a delay in the erection of forms if the specifications are to be rigidly followed.

Nearly every one is familiar with the "hollow" sound when walking over some concrete floors. That sound presupposes the absence of a bond between the base and the topping—the very thing the specifications writer sought to avoid, but did not. To insure against such a condition, and to turn out a better floor, the following treatment has been practiced with rare success.

After the base has been placed, and shortly after the initial set has taken place, train and delegate an intelligent laborer to sweep the floor briskly with a long handled steel brush. There is a psychological moment for doing that sweeping and a close watch over the concrete will point it out. The time will have been too early if the coarse aggregates can be disturbed and be made to rock in the mortar, and too late if the concrete does not give off sweepings that resemble for identification the almost too dry mixture used in the making of some concrete blocks. Then what has been accomplished is this: All laitance has been removed and both fine and coarse surface aggregates are faced with the same virgin cleanness of the storage piles.

The next step, and the final one before placing the topping, whether it be placed a week or a year afterward, is to wash off and steel broom the base again, sweeping off all excess water. Ahead of the topping thoroughly brush in a scant sprinkling of neat cement, taking care not to get too far ahead of the applied top coat. The neat cement aids in securing a thorough bond, and has the merit of absorbing the excess water. The use of too much cement for sprinkling is, of course, to be avoided.

By watching carefully the sweeping of the slab, cleavage between the base and the topping will never result under any conditions. That has been proved. And always, a thick topping coat can be dispensed with by applying a thinner coat, thinner in thickness, that is, and the latter will meet every requirement of the former.

Finally, the operation of floor finishing can be made a portion of work with which nearly all other operations need not conflict. The cost of protection, such as covering with a layer of sand, etc., is not a factor to consider.

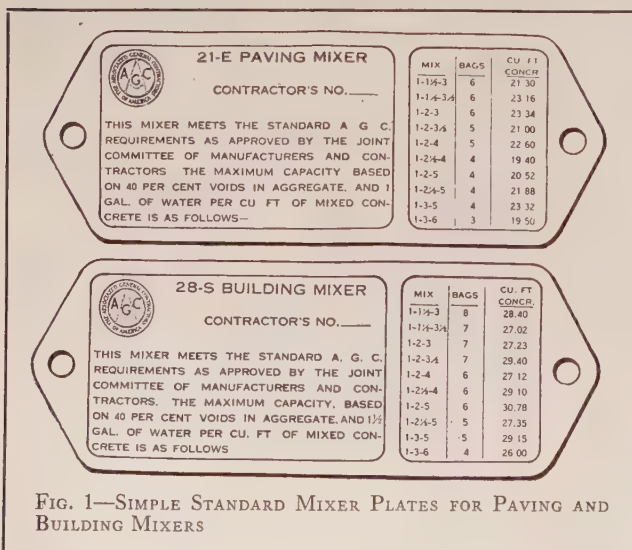


FIG. 1—SIMPLE STANDARD MIXER PLATES FOR PAVING AND BUILDING MIXERS

1924 Marks Centennial of the Present Cement Industry

RECORDS of the British patent office show that in 1824—just one hundred years ago—an English bricklayer, Joseph Aspdin, was awarded a patent for a material he called “portland cement.” At that time a number of men were engaged in experiments in an effort to produce a cement superior to the natural cements then in use. As far back as 1756, John Smeaton, an English contractor, discovered that an impure limestone containing a certain amount of clayey matter possessed decided hydraulic properties when burned. Aspdin’s contribution was his discovery of the value of taking proper proportions of different ingredients and then pulverizing and mixing them thoroughly before they were burned into clinker, which later was finely ground. He called his material “portland” cement because when it hardened it resembled a building stone quarried on the Isle of Portland.

Although Aspdin’s invention was brought out in 1824, it was not until 1872 that the portland cement industry started in the United States. Of course natural cements had been used here for years, and in the late sixties imported portland cement was gaining a strong foothold in the American market. In 1872, David O. Saylor established a plant for the manufacture of portland cement at Coplay, Pennsylvania, and so far as can be ascertained this was the first plant of its kind to be started in this country. Within a few years other plants were built at South Bend, Ind., Kalamazoo, Mich. and various parts of the east.

Many interesting stories are told in connection with the early efforts to produce portland cement

in the United States. One man used a cookstove in which to burn rock while conducting his experiments. Another used a piece of sewer pipe as a kiln, and ground his materials in a coffee mill. Still another pressed a bent car-axle into service as a part of a grinding machine. For a number of years the reputation of imported cements was so strong that American manufacturers had a difficult time in securing a market for their product. It was not until the late nineties that the home product took its place on an equal footing with imported cement, and eventually won the market.

One hundred years after the invention of the material, the plants of the United States are producing more portland cement than the rest of the world combined. United States Geological Survey figures indicate that about 135,000,000 bbls. were made in this country in 1923.

This development has necessitated the revolutionizing of methods of manufacture. Where the early pioneers used crude dome-like kilns for burning their raw materials a modern plant contains huge rotary kilns—steel brick-lined cylinders each of which may weigh as much as eight Pullman cars. One of these great modern kilns will produce as much clinker in a day as one of the old kilns could turn out in a year. The old fashioned grinding machinery has been supplanted by a variety of crushers and roll, hammer and ball mills, in which the raw materials and clinker are reduced to a powder finer than flour.

The centennial of the invention of portland cement is an important date in industrial history, and will be fittingly observed by various organizations in the building field.

The American Concrete Institute’s 20th Anniversary Plans

It is interesting that in 1924 we celebrate not only the hundredth anniversary of the patenting of portland cement but the twentieth anniversary of the founding of the movement for better concrete in a national organization of users of cement.

The work of organization in preparation for the first convention of the National Association of Cement Users began in the summer of 1904. The idea appears to have originated with A. S. J. Gammon, of Norfolk, Va., who, interested in the improvement of the early practice of concrete block manufacturers, wrote to Charles Carroll Brown, of the Municipal Engineering Co., Indianapolis. He in turn interested a great many in forming an organization. The first program was presented and the organization effected at a convention in Indianapolis, January 17-19, 1905. This was the National Association of Cement Users.

In opening the meeting, Mr. Brown pointed out that the production of cement in the United States had doubled every four years for some time, bringing the figure to the enormous total of 23 million barrels in 1904. (Compare with about 135 million barrels in 1923); and that “the use of cement is not so simple as it might seem and much bad work has resulted as a consequence of many people trying to manufacture cement products who know nothing about the materials with which they have to work.”

The papers presented at that first meeting which was chiefly concerned with the future of concrete blocks, included the following:

“Coloring of Concrete” by J. P. Sherer, Milwaukee.

“The Dry Mixture of Concrete” by A.L. Goetzmann, Chicago.

"Practical Work of Constructing Sidewalks" by A. T. Gridley, City Engineer, Aurora, Ind.

"The Waterproofing of Concrete Blocks," by G. B. Kirwan, St. Louis.

"Waterproofing Concrete," by W. H. Finley, principal assistant engineer, C. & N. W. Ry.

"Cement Posts," by J. A. Mitchell, Goshen, Ind.

"Mortar Sand," by J. C. Hain, Engineer of Masonry Construction, C. M. & St. P. R. R., Chicago.

By-laws were adopted and officers were elected as follows: President, Richard L. Humphrey, Philadelphia; 1st vice-pres., Merrill Watson, New York city; 2nd vice-pres., John H. Fellows, Scranton, Pa.; 3rd vice-pres., H. C. Quinn, Dublin, Ga.; 4th vice-pres., A. Monsted, Milwaukee; secretary, Charles Carroll Brown, Indianapolis; treasurer, A. S. J. Gammon, Norfolk, Va.

The volumes of the *Proceedings* of the National Association of Cement Users and its successor, the American Concrete Institute, which have come along after the first thin book from which the foregoing history was gleaned, record step by step, our progress in concreting.

As the applications of the material have multiplied, the problems have multiplied, and the need of cooperative effort in solving them, apparent 20 years ago, is imperative now.

THE COMING MEETING

The 20th Annual Convention of the American Concrete Institute, to be held in Chicago next month (February 25-28), will add another volume to our increasingly valuable library; and for one day of the four it will pause to review what has been done and how, and to prophesy a little as to which way we are headed for future developments.

Very able men in various departments of the work of the field will draw these word pictures whose effectiveness will be greatly enhanced by an exhibit in a large room adjoining the convention to show in models, pictures, samples and graphs just what is meant by progress in concreting.

With the convention still more than two months away, there are the best of reasons to believe that it will offer more of practical value, more of worthwhile acquaintance, and more thoroughly enjoyable features than any convention the Institute has ever held.

Good conventions are made out of the efforts, not of a few men, but of many. Certainly there has never been a time in the history of the Institute when more able men were giving valuable thought, time and solid effort for the success of a meeting than now. This effort began last April and plans are being rounded out in such a way that their efforts will be rewarded.

Institute membership has passed the eleven hundred mark—not the boom membership of the early days, but the steady climb that indicates the growing appreciation of an organization that is proving itself by real service.

Henry C. Turner, chairman of the Institute's 20th Anniversary Committee, reports splendid progress on the part of all of the sub-committees assigned to various tasks involved in making one day of the next convention a particularly bright spot in the celebration of the Institute's twenty years of effort for better concrete.

The assignments for the historical symposium are as follows:

RICHARD L. HUMPHREY, "Presentor" of the General Outline.

A. N. JOHNSON, Concrete Roads.

JOHN J. EARLEY, Architectural Concrete.

A. E. LINDAU, Bridges.

DUFF A. ABRAMS, Making Good Concrete.

A. N. TALBOT, Engineering Research.

M. M. UPSON, Piles and Waterfront.

ALBERT KAHN, Reinforced Concrete Buildings.

F. W. KELLEY, Cement Manufacture.

A. P. DAVIS, Dams, Tunnels, Conduits, Culverts.

A. W. RANSOME, Mechanical Equipment.

R. F. HAVLIK, Concrete Products.

The leader for each subject is cooperating with John J. Earley in working out the details of the exhibit, to make this feature of the convention the means for an impressive picture of progress in twenty years.

One of Mr. Turner's sub-committees is raising funds to make this Anniversary day of first rate importance. Several thousand dollars will be spent to make it worth while, educationally and as a means of closer and broader acquaintance and a good time.

The Anniversary day program (Feb. 27) will be concluded with a dinner, Robert W. Lesley, toastmaster, a limited number of very worthwhile addresses (Col. Charles R. Gow, John R. Morron, Lorado Taft) and some special entertainment features.

George E. Warren, assistant general manager of the Portland Cement Association, has accepted the chairmanship of a Chicago Membership Committee in which unusual efforts will be made for a considerable increase in membership in the Institute in and around Chicago.

WHAT THE MEETING WILL DISCUSS

Items of the convention program will include important reports on the following subjects:

Concrete and Reinforced Concrete, final report of the Joint Committee.

Culvert Pipe Joint Committee progress report.

Reinforced Concrete Building Design and Specifications, design coefficients for two-way slabs; a current history summary.

Fire Resistance of Concrete.

Aggregates for (a) Concrete used in precast building units. (b) Concrete used in general structures (including reinforced concrete). (c) Concrete used in road slabs. (d) Concrete subjected to the action of sea water.

Serious Concrete Failures and their Causes and Remedy.

Waterproofing.

Types of Expansion Joints in Concrete Construction.

Reinforced Concrete Chimneys.

Building Regulations for Concrete Houses.

Contractor's Plant: the design of a concrete plant suitable under any condition.

Specifications for Concrete Side-walk Construction.

Methods to be used in the refinement of floor finishes for residences and other exacting uses.

Measurement of and Estimating Concrete.

Control of Quality of Concrete on the job.

Revision of the Tentative Standards for Brick, Block and Tile.

Concrete Products Plant Operation.

The Control of Quality in Block, Brick and Building Tile.

Concrete Staves—tentative specifications.

Fire Resistance of Concrete Block: report of tests of block panels.

Specifications for Concrete Drain Tile, Plain Concrete Sewer Pipe and Reinforced Concrete Sewer Pipe.

Concrete Roof Tile—color problems.

One session of the convention set apart from the general meeting, will be for the informal discussion of pressing products problems by concrete products manufacturers among themselves, with such assistance from technical advisors as will be called upon to discuss particular problems. Products manufacturers have asked for the discussion of:

(1) How to control quality during manufacture.

(2) How to advertise to reach architects, contractors and owners.

(3) How to effect proper cooperation of products manufacturers with users of their products in getting more general agreement as to sizes and styles of products.

(4) How should costs be kept—on the basis of number of units, cubic yards of concrete, tons of finished products, or will each different class of units require a different cost basis?

(5) Precisely, how is the concrete products manufacture to proceed to effect the use of a mix of the proper grading and of the greatest economy?

(6) How are we to get the buncombe out of advertising—machines—materials—compounds—systems—patents, and reduce the competition in types of products made?

(7) How to organize and carry out a system of regular weekly or

monthly tests of quality of the products manufactured in any one community.

(8) Should dry-tamp block manufacture be discouraged in favor of poured products?

(9) Should the products manufacturer be compelled to buy his cement through a dealer who would be just as willing to sell a clay brick foundation?

(10) What success have products manufacturers had with calcium chloride or with specially prepared compounds for accelerating the hardening of block? Are these materials detrimental to concrete?

(11) How important is the factor of absorption? What governs absorption, and what are the effects of low or high percentages?

A good deal of interest has been shown in another special meeting of the convention organized especially for superintendents and others directly in charge of concrete construction on the job. A number of the big contractors have furnished the secretary of the Institute with the names of superintendents and offered co-operation for the success of such a meeting.

Robert F. Havlik, with several assistants from Mooseheart, will show products manufacturers the operations involved in mold-making, casting and finishing of high-grade concrete surfaces. Arrangements are being made to give Mr. Havlik an entire convention period, a morning, an afternoon, or an evening for a thorough demonstration which he has promised to undertake. The fact that Mooseheart is close by Chicago will make it possible for him to bring several assistants and have several operations in progress at the same time, to avoid the delays which come in the pauses between the various steps in making ornamental objects.

Arrangements have been made by the Institute for special railway rates by the certificate plan for members and delegates attending the convention.

Accelerators for Concrete

Lowering the Freezing Point in Cold Weather Work

From the United States Bureau of Standards in Response to an Inquiry from the Magazine CONCRETE prompted by a Correspondent's Questions.

Contractors and others directly concerned with concrete construction are being offered a great variety of proprietary hardening and anti-freeze compounds, particularly at this season of the year.

Your correspondent's question is, therefore, a very pertinent one, and any institution or organization which could furnish reliable information on the effectiveness of these proprietary compounds would be capable of rendering the public valuable service. On the other hand there is a vast amount of work involved in the testing of many compounds, and there are few organizations, if any, in a position to provide the necessary funds for such work. It is also doubtful whether any Government agency, such as the Bureau of Standards, would be warranted in making an extensive investigation of these compounds. If an investigation were made by the Bureau, public policy at the present time does not permit the findings to be reported openly, and the value of the investigation to the general public would therefore be questionable. The information would of course be available to the Government Departments, and might be furnished confidentially to those who ask for it, but the frequent abuse of privileges of this sort does much to discourage the dissemination of results of tests on proprietary compounds.

Referring specifically to the use of accelerators and anti-freeze compounds in concrete construction, we know that the majority of them, if not all, are based on calcium chloride, in some cases mixed or combined with other materials. The effect of these other materials is problematical—in two types we have noted an appreciable increase in workability over the plain calcium chloride solutions, but in general the acceleration of hardening and the advantage of use in cold weather may be attributed mainly to the action of the chloride. The majority of the proprietary accelerators that we have tested are essentially about 30% solutions of calcium chloride and the directions for use call for dilution with five to twenty parts of water, depending on conditions. For ordinary purposes, the use of ten parts of water is commonly recommended, giving about a 3%

solution of chloride for gaging the concrete mixture. In our investigations this amount of chloride has been found to be generally satisfactory for accelerating the time of set and the early hardening.

With reference to anti-freezing effects, we have no definite information from systematic tests. A few isolated tests indicate that the freezing point of a concrete mixture gaged with a solution of calcium chloride is slightly lower than the freezing point of the solution itself. Roughly, the freezing point of solutions of low concentration is lowered about 1° F. for each per cent of chloride in solution. The old rule of using not more than 10% of chloride is a safe one to follow, and if temperatures lower than 20° F. are anticipated, additional precautions should be taken to protect the concrete from freezing.

In connection with the use of accelerators of the calcium chloride type the question of corrosion must be considered. Tests were made by the Bureau several years ago in which 1:3 mortar slabs containing metal lath, with and without calcium chloride, were exposed on the roof of one of our buildings. Quite serious corrosion of the lath in the slabs gaged with chloride solution was noted at the end of a year while none was apparent in those gaged with water only. As a result we have recommended against the use of chloride in cement stucco on metal lath. On the other hand a number of 6-in. x 12-in. concrete cylinders containing 8-in. x 1/2-in. round steel rods which had been gaged with calcium chloride solutions and had been exposed on the roof for periods of five and six years were broken last summer, and no serious corrosion was found in 1:2:4 and 1:1 1/2:3 concrete. The corrosion which had developed was apparently localized at a few points where voids had occurred at the surface of the steel, and did not appear to be progressive. The strength of the concrete containing the chloride was in all cases higher than that of the concrete gaged with water only. The foregoing results have been confirmed to some extent by a limited number of accelerated tests in the laboratory.

On the basis of information available to date, it would appear safe to use calcium chloride in gaging reinforced concrete when the concrete is not to be

exposed to dampness or directly to the weather, and when careful workmanship can be insured. For outside reinforced concrete work it is better not to use chloride—the probability that the steel will not be perfectly embedded and protected is too great under ordinary job conditions.

* * *

From a letter from the Dow Chemical Co.

We have done a considerable amount of research work on the use of calcium chloride in proper proportions to prevent concrete from freezing and our conclusion is that if concrete is to be continuously exposed to a temperature of 15° F., it is inadvisable to use calcium chloride as the only preventive. The reason for this is that although the concrete with calcium chloride present is very much stronger at a given age than without the calcium chloride, still at the end of 28 days it does not attain what would be termed a reasonable strength.

We are recommending for all frost protection purposes the use of 6% calcium chloride, based on the weight of the portland cement used in the mix; in other words, six pounds of flake calcium chloride per bag of cement. We find that lower percentages will give some protection but that the 6% will give much better results. We do not find any definite temperature at which a definite per cent of calcium chloride can be recommended. We find that all our curves are without any abrupt break. It is unusual, perhaps, that a concrete should be exposed continuously to a temperature of 15° F. for any great length of time, and, under a condition in which the concrete is exposed to an alternate lowering and raising of temperature, say, between 15° F. and 32° F., it should be perfectly safe to depend on 6% calcium chloride for frost protection. The above statement, of course, is based entirely on the results of our laboratory tests. Calcium chloride has been used in considerable amounts as a protection against freezing, but to date we know of no larger installation in which more than 3% of this salt has been used.

* * *

From the Wisconsin Concrete Products Association.

The effect of calcium chloride on the strength of concrete is discussed in Circular Letter No. 41, of the Wisconsin Concrete Products Association under date of January 2, 1924 as follows:

Calcium chloride is one of the materials used for accelerating the hardening of concrete. As this is a subject of considerable importance at this season of the year, we are giving you in a general way the results of a series of tests conducted by Prof. Duff A. Abrams at Lewis Institute, Chicago.

The results of these investigations showed that from 2 to 4% of calcium chloride by weight of the cement may be used without reducing the strength of the resulting concrete. The exact percentage of calcium chloride to be used may be altered between these limits to fit any particular condition. The calcium chloride should be dissolved in the mixing water before it is introduced into the mixer.

Calcium chloride also has the effect of depressing the freezing-point of water, which is desirable in cold-weather work. However, the indications are that calcium chloride in amounts greater than 6% by weight of the cement will reduce the strength of concrete below that of similar concrete without calcium chloride; this fact should not be overlooked when determining the percentage of calcium chloride to be used in a given case.

In general, the best results in concrete work carried out in extremely low temperatures will be secured by:

- (1) Heating the mixing water and aggregates; aggregates can best be heated by placing steam coils in the bins.
- (2) Protecting the work from wind and snow with canvas or temporary timber structures and heating interior by means of steam pipes or salamanders.
- (3) Using calcium chloride to lower the freezing point of the mixing water, and to increase the early strength of concrete.

Graded Aggregate

Good Advice for Authors

Dr. H. Foster Bain, director of the Bureau of Mines, in a memorandum to his technical staff, writes as follows:

Some tendency has begun to appear for the authors to attempt to crowd too much into a report. It should be remembered that the editors of the various journals work under limitations as to space and time and cannot use long articles. Neither do they always have time to digest and summarize something which the author has not felt sufficiently interested in to boil down to simple essential statements. In the end, a much larger audience will be reached more promptly if time be put on thinking out the few right words than on writing many that are about right. Study condensation. Analyze your material. Select your best illustrations rather than list all you know. A report that runs to more than ten double-spaced typewritten pages will be put aside by many editors to condense later—and next week something else takes his time.

The advice to bureau men is good. We commend the same ideas to other technical writers.—*Chemical and Metallurgical Engineering.*

* * *

In Wayne County, Michigan

The Seventeenth Annual Report of the Board of County Road Commissioners of Wayne County, Michigan, is interesting because it does not rest its case on being the daddy county of them all in concrete road building. It visions something of the future—of what an interurban highway may eventually mean. Edward N. Hines “the father of the concrete road,” chairman, and his confreres of the Board, Messrs. Haggerty and Butler, may properly be permitted a certain amount of “pointing with pride” to their report to the Supervisors, for looking back to the venture of 15 years ago when Wayne County put down an experimental half mile or so of concrete road. A good deal has come of it. There are now the equivalent of almost 30,000 miles of 18-foot concrete roads in the United States, not including about 12,000 miles of concrete street pavements. Many of the older Wayne County roads have been widened, fine bridges built, wider rights of way secured for future development; the separation of railway and highway grades has begun; highway lighting systems inaugurated; roadside tree planting has progressed; county parks are being developed; road markings have been extended and improved. It is with the road as with many other of civilization's developments. Its original purpose but clears the vision for its more perfect uses. It is not a mere means of easy traction, a mere tape measuring the distance between two places; the road, in our more perfect understanding of its possibilities, is in itself a destination and we expect of it, with the expansion of our imagination, that it shall be beautiful as well as useful, as trees and footpaths and parks and perfect upkeep can make it. Mr. Hines and his associates on the Board who are also the Board of County Park Trustees, are to be congratulated and Wayne County is to be congratulated for a vision of the highways of the future and for the necessary courage to begin their achievement.

* * *

Important Block Tests Carried On in Milwaukee

A series of experiments of unusual interest on the manufacture of concrete products has been carried out in the plant of A. W. Devos Co., Milwaukee.

Using aggregates available to practically every con-

crete products manufacturer in Wisconsin 168 batches of concrete were mixed and made into block on the Post Economy Punch and the Anchor Stripper machines in the Devos plant. These 168 batches represented various combinations of the five aggregates used and were mixed in 1:5, 1:7 and 1:9 proportions. A fineness modulus was recorded for all aggregate and the various batches were proportioned under the direction of a representative of the Structural Materials Research Laboratory, Chicago, and an engineer from the general office of the Portland Cement Association.

The materials used were fine bank run sand, limestone screenings, coarse sand, pebbles running to $\frac{3}{8}$ in. and pebbles running to $\frac{3}{4}$ in. By putting these materials together in proper proportion various fineness moduli ranging from 2.40 to 5.00 were arrived at.

After the block were made they were separated into two groups for curing. One group was kept moist for different periods, the other was allowed to remain in the air and no water added. Another interesting phase of the test was a comparison of the relative efficiency of batch and continuous mixers.

While some of the block were tested at 7, 14 and 21 days, the majority were subjected to the testing machine at Marquette University at 28 days. Absorption tests are now being run at Marquette University, which is cooperating in the testing of the block. As soon as these are completed, the data on the experiment will be tabulated, and will probably first be given to the public at the convention of the Wisconsin Concrete Products Association.

A careful check has been made on every operation performed and when the complete result is tabulated, Wisconsin concrete product manufacturers will be able to learn just what combination of materials will be most economical in making a block that will meet the requirements of the Wisconsin Industrial Commission.

* * *

Tests of "Composition" Floors and Stuccos

Comparatively few people, who walk on oxy-chloride cement floors, or who live in houses having exterior walls of oxy-chloride cement stucco, are familiar with these materials, says the Department of Commerce. In fact, very often the architect or builder knows oxy-chloride cement products only in connection with trade names. The rapidly increasing demand for these materials is significant of certain desirable peculiarities, and has made it necessary to replace haphazard or "rule of thumb" methods, in the manufacture and use of this cement, with more scientific methods based on the study of numerous tests.

The U. S. Bureau of Standards has issued Technologic Paper No. 239, entitled, "Tests of Caustic Magnesia Made from Magnesite from Several Sources."

Caustic magnesia, the chief constituent of oxy-chloride cement, was made in the experimental cement plant by calcining magnesite ore. The temperature and other conditions were varied in order to study the effects on the properties of the product. An ore imported from Greece, one shipped from the state of Washington, and two from different mines in California were used, as these were representative of the chief sources of supply for this country. Cement mixtures, typical of those used by the trade, were then made and tested by laboratory methods, and in actual service. The service tests were conducted on panels of flooring and stucco exposed to actual service conditions. The results of this work add to the information necessary in producing the most satisfactory oxy-chloride cement products.

January, 1924

Dana Pierce has been elected president of Underwriters Laboratories, A. R. Small first vice president. D. B. Anderson and L. B. Headen continue as secretary and treasurer, respectively.

* * *

Pacific Avenue

An important piece of road work has recently been completed on the Pacific Coast—Pacific Avenue, a 700-mile unbroken paved highway, from Vancouver, British Columbia, across the international boundary line and through two states, Washington and Oregon, to the northern state line of California.

All of the recent construction work on the highway is according to the Illinois state standard. It is 20 ft. wide with more width on all curves. The edge is 9 in. deep and $6\frac{1}{2}$ in. at the center.

The road is of a 1:2:3 mixture with lateral expansion joints in the center and cross-wise expansion joints every 20 ft. All grades have been minimized so that the maximum load climbs them all in high gear. Curves are long and sweeping. In congested centers the width of the highway is increased.

The last 37 miles in Washington were completed in four months' time, excavation and fills included. Much of the road had to be built one side at a time and kept open to traffic. Thirty-seven miles of excellent detour road was built. Ten thousand dollars was spent on detours alone to keep them in condition for travel.

A total of 320.9 miles of concrete is included in the highway, 9.6 miles of brick and 278.8 miles of bituminous work of various kinds. In British Columbia alone are 21.1 miles of concrete and 12.3 of bituminous. In the state of Washington, 9.6 miles of brick, 21.9 of bituminous and 234.1 of concrete. In Oregon are 65.7 miles of concrete and 244.6 miles of bituminous.

The remainder of the 700 miles is included in city limits and is of mixed construction.

The cost of construction work where there were no heavy fills or cuts, runs over \$30,000 per mile. With the blasting work, balustrades, fills, etc., cost runs closer to \$50,000 per mile.

When but 114 miles of paving are completed in northern California, the Pacific Avenue will extend in unbroken length of pavement from Vancouver to Tia Juana, Mexico, 1600 miles in all and passing through cities and communities with a total population of more than 5,000,000. Contracts have already been let for the construction of the remainder of the road and the pavement is expected to be completed within the next two years.

* * *

Manufacturers of Poor Products Should be Eliminated

W. C. Muehlstein, Building Engineer, Wisconsin Industrial Commission, says in the *Wisconsin Concrete Products Digest*:

"Regulations of any kind are designed for the benefit of the greatest number and are not intended to be detrimental to any good individual cause," says W. C. Muehlstein, building engineer, Wisconsin Industrial Commission in the *Wisconsin Concrete Products Digest*. "The concrete block industry is no exception. Recent regulations put into effect by the Industrial Commission were considered necessary to protect the public from the dangers of improperly made concrete products as they have been made in the past. These regulations will not work a hardship on any one and will not only afford protection for the public but will greatly improve the status of the block industry. Prejudice against the

general use of concrete block and tile has developed because of the lack of proper control and consequent indifferent processes of manufacture.

It behooves every maker of concrete products to get in line and not only conform to good regulation but also to see that others do it. The sincere maker will pay, in prestige and goods, the cost of any and all poor block and tile permitted to be marketed."

* * *

The Road Show and Convention

The 14th American Good Roads Congress, the 21st Annual Convention of the American Road Builders' Association and the 15th National Good Roads Show, Chicago, January 14-18, offer a near event, between the end of one road-building season and the beginning of another, of unusual importance—probably a bigger event than anything of its kind heretofore.

The show will be in the Coliseum and adjoining buildings; the convention in the Congress Hotel. The convention program is announced as follows:

Tuesday, Jan. 15, 10 a.m.—President's Address, Frank Page, Chairman, State Highway Commission of North Carolina, Raleigh, N. C.; "Highway Improvement a Continuing Business," Thomas H. MacDonald, Chief, Bureau of Public Roads, Washington, D. C.

MATERIALS AND DESIGN

Tuesday, Jan. 15, 2 p.m.—Chairman—S. L. Squire, Deputy Minister of Highways, Ontario, Toronto, Ont.; "Recent Development of Bituminous Base and Sand-Asphalt Road Construction," E. R. Olbrich, National Research Council, Washington, D. C.; "Outstanding Problems in Highway Bridge Design—Surface, Width, Vulnerability, Ground Plan," E. F. Kelley, Senior Highway Bridge Engineer, Bureau of Public Roads, Washington, D. C.; "Smoothness as a Factor in Pavement Life," A. T. Goldbeck, Chief, Division of Tests, Bureau of Public Roads, Washington, D. C.

TRAFFIC AND MAINTENANCE

Wednesday, Jan. 16, 10 a.m.—Chairman—R. Keith Compton, Chairman Paving Commission, Baltimore, Md.; "Traffic Surveys—Methods and Costs," H. E. Hamlin, Superintendent of Repairs, Connecticut State Highway Commission, Hartford, Conn.; "Traffic Surveys—Findings and Deductions and their Lesson for the Road Engineer," J. G. Mackay, Bureau of Public Roads, Washington D. C.; "Snow Removal—Organization, Methods and Equipment," Edward E. Reed, Assistant State Highway Engineer, New Jersey State Highway Commission, Trenton, N. J.; "Central Plant Maintenance—Possibilities for Large Concentrated Mileages," Leroy C. Smith, Engineer Manager, County Road Commissioners, Wayne County, Detroit, Mich.; "Highway Traffic Accidents—Classifications and Causes," N. M. Isabella, Assistant Maintenance Engineer, Wisconsin Highway Commission, Madison, Wisc.

ADMINISTRATION

Wednesday, Jan. 16, 2 p.m.—Chairman—Frank Page, President, American Road Builders' Association; "State Cement Manufacture a Highway Administration Policy," (1) "Merchandising and Transport Conditions Which Prompted Consideration of State Purchase and Manufacture of Cement Road Building Materials," B. F. Piepmeier, State Highway Engineer of Missouri, Jefferson City, Mo.; (2) "State Purchase and Storage as a Means of Regulating Cement Supply and Price Without State Manufacture," C. N. Connor, Construction Engineer, North Carolina State Highway Commission, Raleigh, N. C.; Election of Officers; Business Session.

JOINT SESSION WITH THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

Thursday, Jan. 17, 10 a.m.—Chairman—John W. Cowper, President, Associated General Contractors of America, Buffalo, N. Y.; "Purpose and Progress of Equipment Standardization," C. E. Bennet, President, Novo Engine Co., Lansing, Mich.; "Standard Highway Contracts a Public Service," General R. C. Marshall, Jr., General Manager, Associated General Contractors of America, Washington, D. C.; "Economic Aspects of Day Labor Construction," Arthur S. Bent, Bent Brothers, Los Angeles, Calif.; "Bonds as a Gage of Responsibility," H. H. Wilson, Managing Partner Winston & Co., Harrisburg, Pa.

CONSTRUCTION

Thursday, Jan. 17, 2 p.m.—Chairman—Frank Page, President, American Road Builders' Association; "Can We Cut Down the Curing Period for Concrete Roads?" H. F. Clemmer, Testing Engineer, Illinois Division of Highways, Springfield, Ill.; "Simplified Practice a Service to Industry," R. M. Hudson, Division of Simplified Practice, Department of Commerce, Washington, D. C.; "Controlling the Distant Units in a Highway Construction Organization," O. M. Kipp, Construction Engineer, Minnesota Highway Department, St. Paul, Minn.

Cut Construction Costs

The fifth annual meeting of the Associated General Contractors of America will be held January 21, 22, 23 and 24 in Chicago. Officials of the organization state that indications already assure a record breaking attendance. The convention is to be held during the week immediately following the annual sessions of the American Road Builders Association and the Road Show, and a joint meeting of this body with the Executive Board of the contractors' organization will be held January 17.

"Cut Construction Costs" is to be the keynote of the convention. The attack upon costs mainly will be launched through the medium of efforts aiming at fullest capitalization of weather conditions favorable to construction operations, an increased volume of winter building, and storage of building materials during periods of the year when construction is at its lowest ebb. By utilization of these means, it is being pointed out, the contractors' overhead will be reduced. They will be able to avoid the extra expense entailed by the present "sprint and spurt" character of the year as regards construction. They also will be able to hold skilled organizations together.

Not only will contractors who are anxious to secure the benefits of detailed discussion leading to conclusions attend these sessions, officials declare, but engineers and architects in large numbers will be present to make first-hand observations of the developments.

Though strong emphasis is to be placed upon the subject of cost reduction, largely because of the public service involved, many other subjects have advanced through the past twelve months to the point where they are ready to be acted upon.

The list of speakers carried on the tentative program includes many leaders of the construction industry and noted observers of economic conditions peculiar to construction operations.

Addresses will be delivered on the following and other subjects: Economic aspects of day labor; The trend of construction; Operation of the income-tax law; Views on building labor; How to cut construction costs; Purpose and progress of equipment standardization; How to make concrete mixer standards effective; Trade associations and Collegiate preparation for contractors.

Addresses on the following subjects are to be delivered before the indicated divisions of the organization at their separate meetings: Quantity surveys; Relationships between the highway commission and the contractor; Resumption of railway construction; Central concrete mixing plants; and Bonds as a gage of responsibility.

Annual report of joint committee of American Association of State Highway Officials and the Associated General Contractors.

Applications for reduced railroad rates have been filed by Washington headquarters with the railway passenger associations, and favorable action in the very near future is expected. These rates will carry the usual one-half reduction on return trip.

Contrast to the work-a-day side of the convention will be furnished in the extensive entertainment program. Naught more than that need be said in this connection. The General Contractors' Association of Chicago will be host to the visiting contractors and their ladies.

All Year Round Work in New York School Construction

With 54 school buildings and additions under construction in New York city in December, representing a total of about 60 million dollars, William H. Gompert, architect for the New York city Board of Education appeals (address at the December meeting of the New York Building Congress) to the whole building fraternity to get the job done regardless of weather.

"December 10," said Mr. Gompert, "bids were opened for four new school buildings. These amounted to \$4,000,000. At the present time and for the remainder of this month (December) plans will be on the estimating tables for 5 additional school building projects, and the estimated cost is \$4,800,000. There are in the drafting room at the present time in various stages of development plans for 36 additional schools which will provide about 65,000 seats. In the next six months it is expected that practically all bids will be placed under contract and from present indications bids will be requested for the balance of the winter months at the rate of 6 to 8 million dollars per month. All this work must be absorbed by the building industry, and it must be prosecuted diligently both winter and summer by the successful contractors." He stated that the Board of Education was in accord with the spreading of building work over the entire twelve months as it believed that it is the part of an efficient, progressive and energetic building organization to introduce methods and procedures to meet the exigencies of all seasons, and to be particularly resourceful to cope with those occasioned by inclement winter weather.

* * *

Statistics of Manufacture

The Bureau of the Census is now engaged in collecting statistics of manufactures covering the calendar year 1923. These statistics are compiled in accordance with the Act of Congress of March 3, 1919, and the schedules have been prepared after conference with the associations and others interested in the various industries. The schedules were mailed to the manufacturers on January 2 and the Director of the Census is very anxious to publish the statistics at the earliest possible date in order that they may be of the greatest possible commercial value. The manufacturers engaged in our industry are urgently requested to forward their reports to the bureau at the earliest possible date, preferably before the end of January.

* * *

Iowa Engineering Society Annual Meeting

The annual meeting of the Iowa Engineering Society will be held at the Montrose Hotel, Cedar Rapids, Jan. 29, 30, 31 and Feb. 1. This society now has a membership of approximately 550, and for carrying out technical investigations and programs, has been divided into the following sections: drainage engineering, highway engineering, mechanical electrical engineering; municipal engineering, railroad engineering, and structural-architectural engineering. The following is an outline of the program:

Tuesday afternoon, Drainage section technical program; Wednesday morning, General sessions; Wednesday afternoon, Technical Programs in Drainage, Highway, Mechanical, Electrical, Municipal, Railroad, and Structural-Architectural Sections; Wednesday evening, Annual Camp Fire consisting special entertainment, impromptu speeches, and a general good time; Thursday morning and Thursday afternoon, General sessions; Thursday evening, annual banquet and dance; Friday morning, General Program.

Unusual Road Job at St. Casimir, Quebec

BY C. C. LAPIERRE
CANADA CEMENT CO., LTD.

About four years ago the municipality of St. Casimir, Que., carried out what might be termed an unusual experiment in resurfacing a macadam road with concrete. The macadam road was built about ten years previously and was showing considerable surface wear. It was decided to try concrete for resurfacing without regard to any of the established principles.

After removing most of the dirt from the surface with a broom, concrete composed of cement, sand and gravel was spread over the old road, the thickness varying from 1 to 1½ ins. No attempt was made to keep grade, the concrete being smeared on following the contour of the macadam more or less.

While this work was done by inexperienced men in a rather primitive way, the result has been somewhat of a surprise to many. The concrete today shows very little signs of wearing and although there are a few cracks these have not opened up and are not in any worse condition than those usually found on standard pavements of the same age.

This experience prompted the municipal authorities to consider the resurfacing of more macadam along this line. In August 1923, work was begun on a stretch about 2500 ft. long on the principal street in the village. In this case the work was done more carefully as to grade and cross-sections and since its completion, it resembles very closely the 16-ft. standard pavement.

Forms were used and the finished pavement was laid to grade. The method used was first thoroughly to clean the macadam by brooming dry, after this it was washed and broomed again, then water was poured on to complete the cleaning.

Concrete composed of 1 part of cement, 2 parts of sand and 4 parts of crushed stone (passing 1½ in. ring) was spread in the usual manner using a tamper resting on the forms. The paving was crowned 3 ins. The finishing was done with roller and belt. Joints were made at noon and night, a strip of ¾-in. felt material being used. These joints would probably average 40 to 50 ft. apart. The sub-grade was kept well wetted while concrete was being deposited.

A small ½-bag mixer was used. The forms were 2 in. x 3 in. At times these were used on the flat and at others on edge. Iron spikes kept them in place. Cross-section measurements were taken about every 25 ft. and these would show an average thickness in center of 2.20 in., side R 4.10 in., side L 3.31. The varying thickness at the sides was necessary to make up the deficiencies on the sides of the old macadam.

The concrete was kept sprinkled for several days but no earth covering was used. Traffic was kept off the pavement for about two weeks after its completion.

The drainage generally was good, the road running parallel to the river. Catch basins were provided for a few of the low spots, the water being conducted under the road through 9-in. pipes to the river.

It is assumed that the concrete bonded to the old macadam, which was in good condition structurally and quite capable of carrying traffic, the re-surfacing being practically the application of a veneer over a solid well drained base or foundation.

This village is away from any large center and the traffic is nearly all local and consists of about 50% horse drawn and 50% automobile vehicles. There are a few local trucks of about 1½ tons capacity.

New Heltzel Road Equipment

Three new items of Heltzel road equipment (The Heltzel Steel Form & Iron Co., Warren, Ohio) are shown in the accompanying illustrations: Top to bottom, improved automatic subgrader and strike-off; hand strike-off and improved automatic road finisher.

Features of this equipment to which the inventor, J. William Heltzel, directs attention are:

Sub-Grader and Strike-Off—Called "automatic", due to the fact that by pressing slightly on a lever, the strike-off proper to clear the sub-grade or material struck off or graded while machine is being reversed. Picture shows one of the end heads,—two being provided, or one to run on each side of road, either on forms, curb or gutter as required; 12-in. wheels, and when using the machine on curb or gutter these wheels may be reversed so that flange will operate on the inside. Machine weighs on an average of about 1000 lb., yet is operated with greater ease than the common 200-lb. hand strike-off. The cross member is crowned to specifications, and the grader blades are attached on an arc conforming to this crown. The truss used permits a neutral crown specified by a contractor and can be changed at will. The principle in using the Heltzel Automatic is to use the momentum and weight of the machine in striking blows. Ordinarily

required in such case. When the engine is used, only one man is required. The strike-off is raised by eccentrics, and it also has a lateral motion from 4 in. to 8 in. Strike-off actually compresses the concrete by an ingenious arrangement whereby the strike-off blades work from a pivot attached underneath the eccentric straps. Thus the strike-off actually travels on an arc,—compression being about $\frac{1}{8}$ -in. to $\frac{1}{16}$ -in. Those who do not wish tamping, will appreciate this feature. Finisher is provided with tamp and belt as well as the strike-off above mentioned. Anyone of these members may be either operated or idled as desired.

The tamp is provided with levers whereby a hard or soft blow may be struck at will. All the controls are on either side of finisher. In going around curves, either side of finisher can be thrown out of gear.

Machine may be changed to either a wider or narrower width without dismantling. The contractor is generally able to do this work himself. All machines, no matter what width they may be, can be narrowed down to 8 ft. Thus in case it is necessary to build a 16-ft. road in two slabs, this work can be done nicely with the Heltzel finisher as it is so designed that the wheels and flanges can be reversed to run inside the forms. As early as two years ago The Heltzel Steel Form & Iron Co. built a special finisher for this kind of work for New York State—a 16-ft. road in two slabs.

A New Wall Finish

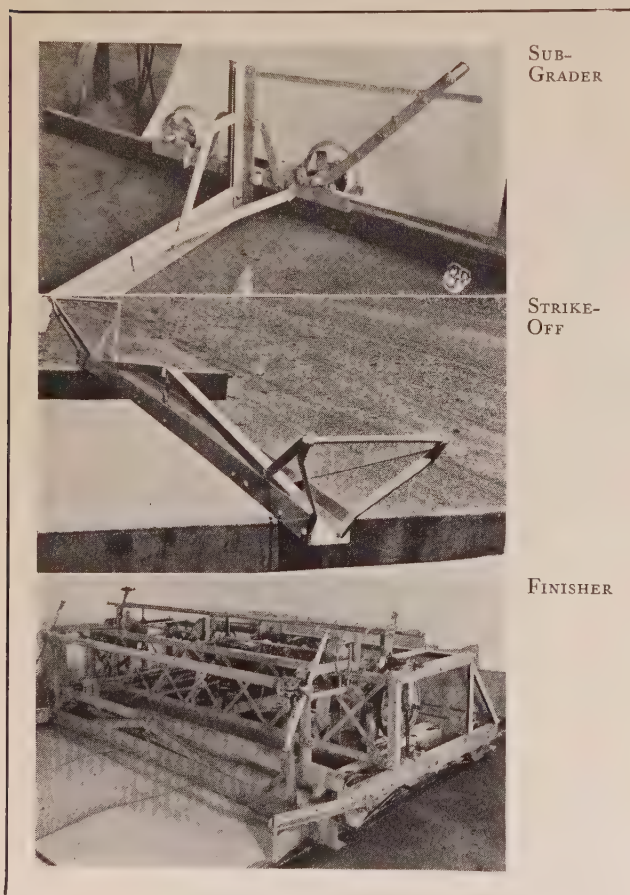
Morene is an emulsion composed of portland cement, sand and asbestos, offered as a new wall finish. It can be obtained in almost any color and due to its heavy body and unusual texture, lends itself to the production of many texture effects. It can be applied over rough sand finish plaster or over smooth plaster, over metal or wood. It can be applied so as to simulate Caenstone, Travertine, unpolished marble, or other surfaces, being marked off into units; or it may be used in unbroken areas. The materials are so combined as to remain in suspension. Morene may be thinned out with one part linseed to two parts turpentine substitute. One coat of it is enough for a rough sand finish but two coats give better results when applied on a smooth surface. The first goes on thin, as a binding coat; the second coat may be stippled with a brush or sponge and while still fresh colored sands blown in, giving variegated effects. The Morene Products Co. is at 245 W. 28th St., New York.

British Concrete Roads

Concrete Publications Ltd., London, England, proprietors of the magazine *Concrete and Constructional Engineering*, frequently quoted in these pages have published a second edition of *Concrete Roads* (Price 5 shillings net. 210 and XVI pp. Illustrated).

The first edition of *Concrete Roads*, published about two years ago, dealt with the first of the roads of this type which had been laid in the United Kingdom and described a number of the principal concrete roads in America and in the British Dominions. The new edition notes the progress made. The number of such roads in England alone has increased by 500% since 1921, and the concrete road is now being accepted by borough surveyors and others as the best type to meet modern conditions. The book gives in handy form particulars of the methods by which nearly all the concrete roads in Great Britain have been laid.

Among the leading contents of the book are descriptions and illustrations of concrete roads in England, Scotland, Wales and Ireland, with latest reports regarding condition, weight of traffic, maintenance cost; descriptions of concrete roads in industrial works; list of engineers and contractors who have laid concrete roads; descriptions of concrete roads in Australia, New Zealand, Canada and America.



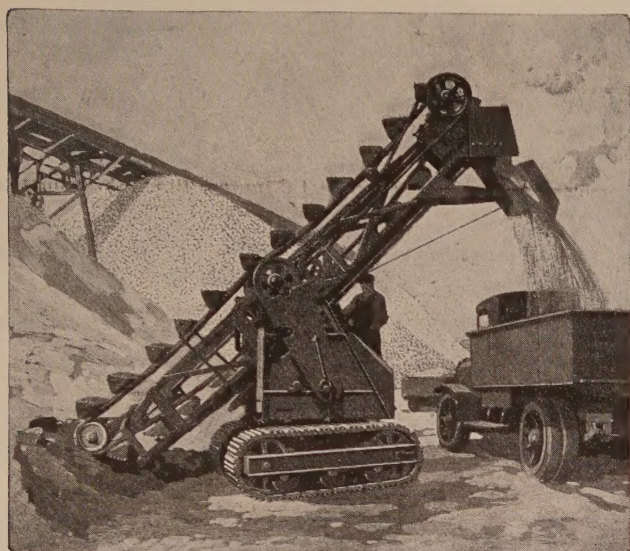
many contractors can use a tractor, roller or truck in drawing the machine forward when it is used for heavy work. If this motive power is in use elsewhere, and when such is the case, it can always be used by hand method. These machines are manufactured from 4-foot for sidewalk work, to 40-foot for road and street work.

New Strike-Off—Consists of a channel of proper width and thickness, and crowned to conform to specifications; adjustable truss is provided and securely fastened to and parallel with the channel, so arranged that the crown in the strike-off may be either increased or decreased as desired, above or below the neutral crown as specified; possible to keep the proper crown as well as change it when desired. In a strike-off of 8-ft. width it is possible to change the crown $\frac{3}{4}$ in., while in an 18-ft. width, twice this amount is possible. Suitable handles are provided for the operators, who can also use the machine for tamping purposes as well as striking off.

Improvements on the Heltzel Road Finisher consist first in the fact that the machine may be used either by its own power or by hand power in case engine trouble should ever develop, two men being

New Crawler Tread Portable Loader Announced

Capable of cutting a path 20 ft. wide, through a pile of material by means of the swiveling feature, is the claim made for the new crawler tread, power-swiveling, industrial loader recently put on the market by the Link-Belt Co., of Philadelphia. It will be



exhibited at the Chicago Good Roads Show, the week of January 12th.

This new industrial loader shown in the accompanying illustration, is known as the Grizzly.

The new feature of the Grizzly loader is the crawler tread. This type of tread has proved eminently successful, and its application to the industrial loader is claimed to be a distinct improvement because of the frequent necessity for moving such loaders over railroad tracks, rough and broken ground, piles of loose material and up inclines.

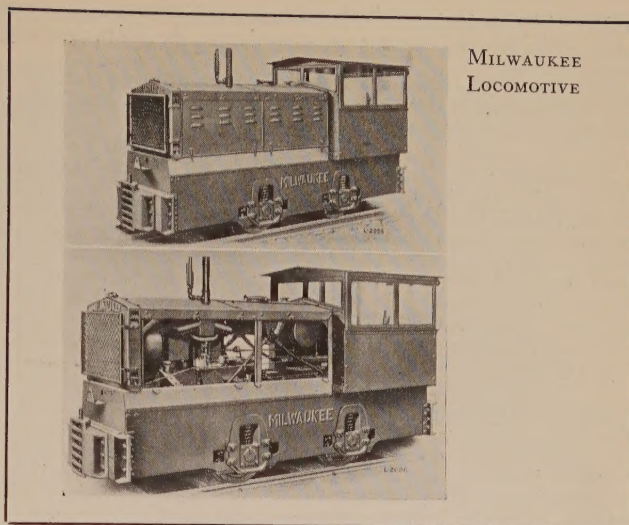
Another feature has been incorporated—that of making the lower base of solid, cast-steel construction. This feature eliminates the numerous rivet and bolt connections and makes for greater durability and rigidity. The lower base, which carries the loading mechanism, pivots on the tread in similar fashion to that employed by the larger and more expensive locomotive cranes.

The capacity of any loader will vary, of course, with the material handled. For the Grizzly, however, a capacity of 45 cu. ft. per minute is claimed while handling bituminous coal. About the same rate of speed is given for sand and about 40 cu. ft. per minute with 1½-in. and under crushed stone. It is driven by a motor of ample power and of standard design.

The New Milwaukee Locomotive

The pictures show the new Type H Milwaukee Locomotive (Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.), built in one standard design for all gages of track in sizes from 3½- to 15-ton, with or without electric starting and lighting. Specifications include these items:

Frame of cast iron sides with reinforced channel iron end sills; couplers of the link and pin or standard M. C. B. type as may be



specified; Hyatt roller heavy duty type bearings; hood of sheet steel with four removable hinged steel side covers; power unit mounted on a sturdy channel iron sub-frame which assures great rigidity and perfect alignment; engine of types H3 and H4 (3½- and 4-ton) machines, known Hercules model O, 4-cylinder, heavy duty type, having a 4-in. bore and 5-in. stroke, and capable of developing 40 h.p. at 1400 r.p.m. for types H6 and H7 (6- and 7-ton) Beaver model JE, heavy duty, four-cylinder type which has overhead valves and removable head. It has a 4¾-in. bore by 6-in. stroke and at 1000 r.p.m. will readily develop 50 h. p. for types H9 and H10 (9- and 10-ton) Beaver 6-cylinder heavy duty type, model JD, 4¾-in. bore by 6-in. stroke and has overhead valves and removable head. Transmission, jaw clutch and gear type, always in mesh, the speed changes and direction of travel being effected by means of jaw clutches. Only two heavy roller chains are employed to transmit the power from the transmission drive shaft to the axles.

Trade Publications

A recent publication of the National Lime Association of interest to engineers, architects and contractors has been issued by the National Lime Association as Bulletin No. 300-A entitled *Lime and Lime-Cement Brick Mortar*.

This bulletin was prepared to fill the need for a short and easily read but accurate summary of the properties in mortar. The essential features of mortar in the wall, cohesive, adhesive and compressive strength, watertightness and economy are discussed clearly and conclusively.

Several tests are referred to and a number of letters from companies specializing on chimney construction and other users of mortar who require maximum results in the mortar they use, are contained in the bulletin to substantiate claims that lime or lime-cement brick mortars have successfully met their requirements.

Functions of mortar, compressive strength of brick work, lime mortar for small house construction, lime mortar in large building construction, tall chimney construction, water-tight walls, materials required per cu. yd. of mortar and mortar for boiler settings are some of the points described in the booklet.

A new illustrated catalog, *Graphic Record Supplies and Mechanical Graphs* has just been issued by the Educational Exhibition Co., Providence, R. I., descriptive of especially prepared materials sold by the company. This is a complete catalog of graphics and describes and illustrates graphs for the use of executives, sales managers, advertising managers, educators, draftsmen, accountants, engineers, statisticians, social service workers and all others who must constantly study quantitative data or present numerical facts.

Insley Mast Hoist Bucket Equipment is the title of a 16-page catalog issued by the Insley Manufacturing Co., Indianapolis, Ind. This catalog describes equipment adapted for use in connection with the construction of concrete buildings such as schools, garages, silos, etc., as a solution for the problem as to how the so-called smaller jobs can be equipped for retaining a proper ratio between plant investment and efficiency of operation.

The steel mast boom plant, steel mast plant without boom chute, wood mast plant and other equipment are described and illustrated by actual construction views showing the equipment in use.

Following its established practice of the past several years, the Link-Belt Company of Chicago has issued a calendar for the year,

1924. The calendar is 16 x 24 in. and each of the twelve sheets contains a large monthly calendar and a smaller size, the month preceding and following.

The illustrations accurately portray the construction features of the various types of Link-Belt equipment shown and have an artistic touch unusual to mechanical subjects.

Vacuum Cleaning, Data for Architects and Engineers, is the name of an 8½-in. x 11-in. paper covered booklet, recently issued by The United Electric Co., Canton, Ohio. The object of this bulletin is to present to the engineer and architect logical and reliable information compiled from long established data and formulae, together with such modifications as are found to apply to the transmission of air through pipes at a high velocity under vacuum instead of direct pressure. The tables on velocity and vacuum loss in pipes are based on actual pipe sizes, such as are found in standard wrought iron or steel pipe.

Standard Specifications for Lime Plaster, Bulletin 305-A issued by the National Lime Association, 918 G. St., N. W. Washington D. C., is a paper covered booklet 8½ in. x 11 in., 16 pages and contains the results of several years' study of field conditions, prepared in conjunction with representatives of the engineering and architectural professions as well as expert plasterers and producers of lime. The specifications are in such form that they may be quoted directly and included in an architect's complete building specifications, or if desired, the short form may be used and the contractor referred to the standard specifications. The bulletin contains only specifications arranged logically and simply, each specification on a separate page.

Seventy Five Years is the name of an attractive book 8½ in. x 11 in., 12 pages illustrated issued by Toch Brothers, New York, on the occasion of the company's seventy-fifth anniversary—1848 to 1923. Toch Brothers claim to have been the first to specialize in the manufacture of technical paint, varnishes and water-proofing compositions, each material being developed from lines requiring special scientific knowledge. A partial list of R. I. W. preservative paints and compounds and also a partial list of structures protected by Toch products are included.

Wheelbarrows, Trucks, Wagons and Cars for Brick, Tile and Sewer Pipe Plants, Bulletin T-1, Toronto Foundry and Machine Co., Toronto, Ohio. 16 pages and cover, 6 in. X 9 in., descriptive of a standard line of wheel conveyors of the line of equipment indicated in the title of the publication. The manufacturers also produce special trucks to specifications.

The General Fireproofing Co., Youngstown, Ohio, has just issued a folder, which will be sent to anyone interested, in which it sets forth the merits of a product which prevents concrete from freezing before it has received its proper set. GF 12 Cement Accelerator added to the mixing water allows concrete work to proceed without interruption or the hazards of freezing weather, even when the temperature drops as low as 17°. GF 12 makes a dense, hard, strong concrete and in no way corrodes reinforcing steel, acting as an accelerator as well as a hardener.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 1807 East Grand Boulevard, Detroit. Convention February 25 to 28, incl., 1924, Drake Hotel, Chicago.

American Concrete Pipe Association; M. W. Loving, Secretary, 111 West Washington St., Chicago. January 17-19, Sherman Hotel, Chicago.

American Engineering Standards Commission; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City.

Associated General Contractors of America; G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C. January 21-23, Chicago.

Associated Metal Lath Manufacturers; 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Rudolph P. Miller, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Iowa Concrete Products Association; Ross Dowell, Secretary, 405 Hubbell Bldg., Des Moines.

Mid-West Concrete Products Association; D. R. Donlen, Secretary-Treasurer, 4340 Marcy St., Omaha, Neb.

National Association of Manufacturers; John E. Edgerton, President; Henry Abbott, Treasurer; George S. Boudinot, Secretary, 50 Church St., New York City.

The National Concrete Stave Silo Association; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

National Crushed Stone Association; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Wisconsin Concrete Products Association; D. R. Collins, Secretary-Treasurer, Milwaukee.

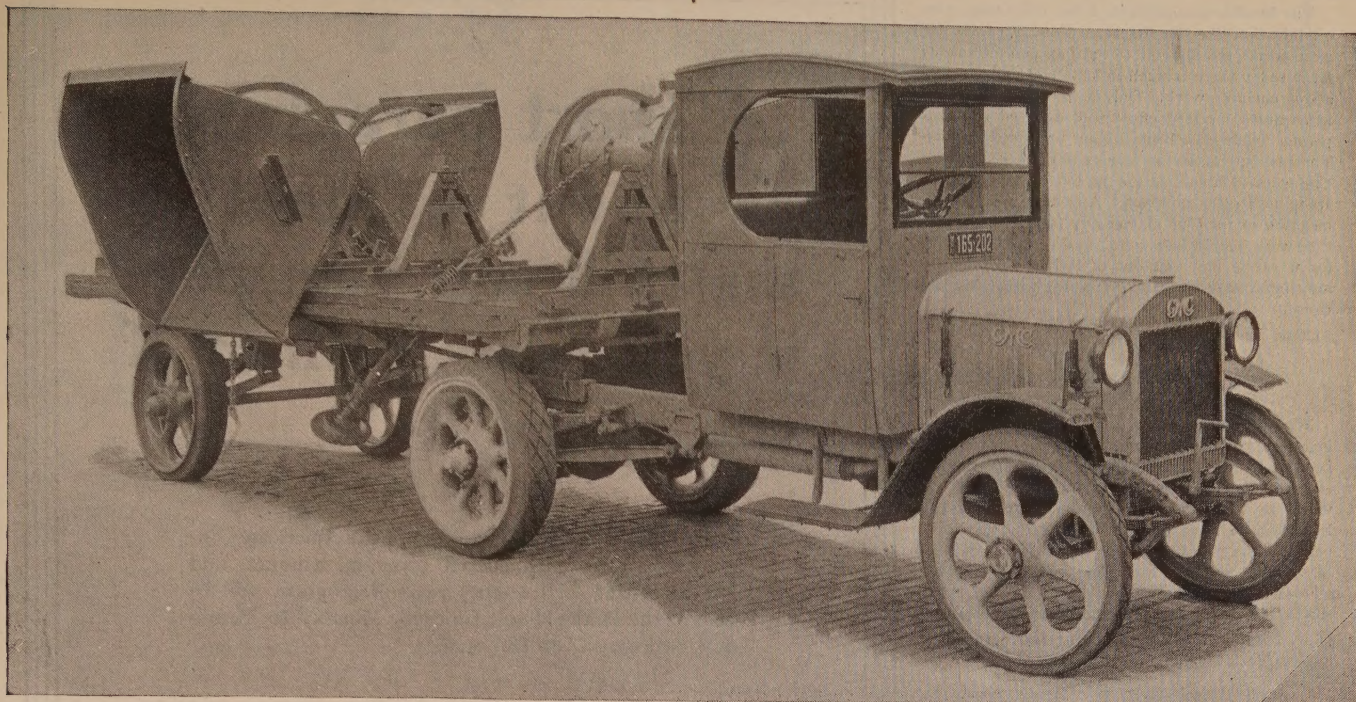
Concrete Drainage Pits for Street Railway

Twenty-one concrete drainage pits were built under the street car tracks on Market street, San Francisco, by the Market Street Railway during the recent reconstruction of that street. Four collapsible forms were used in the construction of the pits. Fig. No. 1 shows the forms in place with the concrete poured. By removing six bolts the forms were easily removed from the concrete and were ready for the next pit. On this concrete there was placed the grating support as shown in Fig. 2 which brought the grating to the top of the steel rails.



FIG. 1—GRATING AND GRATING SUPPORT SET IN POSITION READY FOR POURING CONCRETE PAVEMENT BETWEEN TRACKS

FIG. 2—FORMS AND CONCRETE BOTH IN PLACE



Withstands brutal service the year 'round

The constantly growing preference for GMC trucks by cement manufacturers and contractors is shown by such a typical example as the Western Lime & Cement Co. The great power range of the GMC engine and famous GMC two-range transmission, the strength and durability of the GMC chassis, and the extra low cost of GMC maintenance and operation give GMC a decided advantage over other trucks. And this is especially true in the concrete business, where the service is heavy, where every kind of road is encountered, and where it is essential that a truck give continuous, uninterrupted service.

Full information on GMC trucks, with detailed explanation of GMC features and what they mean to owners, is given in an illustrated booklet, "Seven Steps Ahead." Send for one of these books and see how GMC can make and save more money for you. Just fill and send in this coupon, and your copy will be mailed immediately.

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Albert Kahn

The benefits to be derived from belonging to an organization like the American Concrete Institute seem to me too obvious to need special argument. Even today there is much to be taught and learned about concrete work. Only a free interchange of ideas and concerted effort well directed by competent heads can bring about improved results. The Institute is the one agency to further that end. The work it has already done is the best proof of its value to the members. Any one interested in concrete or for that matter any form of construction work should belong to the Institute not only for what he may get out of it but for what he may be able to contribute towards furthering the cause.

ALBERT KAHN, Architect, Detroit.

H. C. Turner

Working alone one can accomplish little. Working harmoniously in large associations much can be done to guide an industry to promote its success and the financial success of its membership. I value my membership in the American Concrete Institute. I have profited by meeting my competitors, the people I buy from, by the discussion of common problems and aside from this I am an advocate of the up-building of an association which shall truly represent a great and growing industry.

H. C. TURNER, President, Turner Construction Co., New York City.

Ernest F. Bent

The details of construction or manufacture which are developed by committees or studies within the Institute, are so valuable in every day practice in the field and factory; that membership pays big returns in dollars and cents to those who will avail themselves of the opportunities presented.

ERNEST F. BENT, Bent Concrete Pipe Co., Los Angeles, Calif.

W. H. Insley

The greatest value to the concrete industry of the American Concrete Institute which I have observed, and of which every man is a beneficiary whose interests are in any way related to construction work, is in its stabilizing influence. It provides a forum where the problems of the industry can be discussed, and have an authoritative statement of the consensus of opinion of the group. This serves to check the harmful influence of both the ultra conservatives and the reckless radicals, and tends toward sane and orderly progress.

W. H. INSLEY, Insley Manufacturing Co., Indianapolis.

J. C. Pearson

I think the American Concrete Institute's greatest value to me is in the contact it affords with progress that is being made in all lines of concrete endeavor. Second only to this are the opportunities it offers of knowing personally many of the recognized leaders and a host of good fellows in the concrete field—investigators, engineers, architects, builders, products men, specialists. And if I were any one of these, I think my answer would be nearly the same—**profitable contact** with the persons and things in which I am directly interested.

J. C. PEARSON, Chief, Cement Section, Bureau of Standards, Washington, D. C.

N. Ransohoff

Our job is to build machinery, and we design and build it as well as we know how. The next thing we have to do is to sell it, and we find that our selling is easier, cleaner and more satisfactory in every way when we are dealing with a products man who is running his plant on a really engineering basis.

Whether it is coincident or not, we can not be sure, but it so happens that the men who are active in the Concrete Institute, and the men who see there at the meetings, are the same men who are running their plants on the basis referred to above.

N. RANSOHOFF, Vice President and General Manager, The Ideal Concrete Machinery Co., Cincinnati.

4 short paragraphs about a meeting that will cost you more if you miss it than if you attend it!

The 20th Anniversary meeting of the American Concrete Institute, with special program, banquet, and exhibit setting forth twenty years of progress, will be held at the Drake Hotel, Chicago, Monday to Thursday, February 25 to 28.

Make that place and time the occasion for getting together with your customers, representatives, friends.

"Meet me at the A. C. I. Convention, Chicago, February 25 to 28."

Good conventions are made out of the efforts, not of a few men, but of many. There never was a time when a greater number of able men worked to make a convention a practical success.

Meet and know the men whose experience and ideas are making the concrete business a better business every year.

For complete information as to program, special railway rates, membership, address Harvey Whipple, Secretary American Concrete Institute, 1807 East Grand Boulevard, Detroit, Michigan.

Paul Kircher

Members who attend its (American Concrete Institute) conventions and take part in its committee work will receive greater benefit than those who prefer to remain in the background and simply read its **Proceedings**. That is a condition for which the individual and not the Institute is responsible. I have observed that those showing an active interest are always given an opportunity to participate.

PAUL KIRCHER, Manager, Pole Department, Massey Concrete Products Co., Chicago.

F. J. Straub

Through my membership in the American Concrete Institute I have had the opportunity of associating with many of its members, both old timers as well as new ones, and I found them to be real, honest-to-goodness men, interested in what is best for the concrete industry, and thereby I obtained much inspiration, encouragement and assistance in my own affairs.

F. J. STRAUB, Straub Patented Building Blox, New Kensington, Pa.

F. R. McMillan

Attendance at the American Concrete Institute convention I find particularly valuable, in the first-hand knowledge I accumulate from the contacts with so many individuals representing every phase of concrete engineering and construction. The papers and committee reports and the discussion provoked are so much more vital when heard directly from the lips of the contributor. The widening interests which these meetings give me and the ever-widening circle of acquaintances mean more to me than I can tell.

F. R. McMILLAN, Consulting Engineer, Minneapolis.

F. W. Kelley

Concrete is as much a test of the man who makes it, as of the materials of which it is composed. Every man should so equip himself with a knowledge of the art, that his concrete will be a credit to him.

Membership in the American Concrete Institute helps him to measure up to this responsibility.

F. W. KELLEY, President, the Helderberg Cement Co., Albany.